THE

JOURNAL OF GAS LIGHTING,

WATER SUPPLY, & SANITARY IMPROVEMENT.

[REGISTERED AS A NEWSPAPER.]

VOL. XXVIII. No. 688.] LONDON, JULY 18, 1876. [28TH YEAR.] Price 6d.

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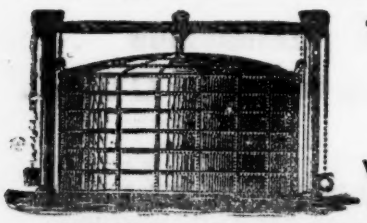

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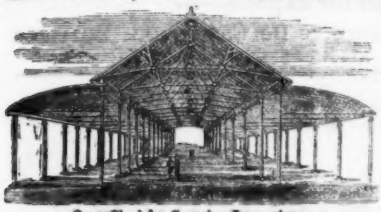

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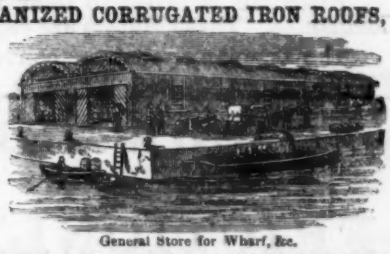

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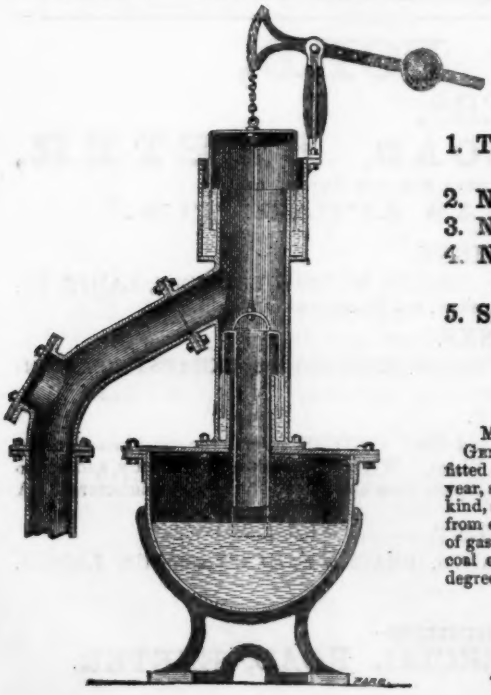

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2. No deposit of Carbon.
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4. Never a choked Ascension-Pipe.
5. Saves Fuel and Wear and Tear.
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7. Is never out of order.
8. Requires no attention.
9. Is perfectly automatic in its action.

TESTIMONIAL.

Tenby Gas-Works, March 29, 1876.

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I am, gentlemen, yours faithfully,

(Signed) EDMUND Z. STEVENSON.

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Beg to intimate to Gas Companies and others that they are now prepared to supply these very superior Meters at the same prices as for the ordinary Gas-Meters.

In the construction of this Meter, for which the best tin plates only are used, every mechanical contrivance has been taken advantage of successfully to reduce the friction to a minimum, which is amply proved by the fact that they are made to work upon only one-fortieth of an inch pressure. By an improvement also in their construction, a steadier light is obtained, and greater capacity than can be got from any other Meter in the market. No gas can pass under the valves on any back pressure, as is the case with many other Dry Meters.

To Gas Companies supplying gas through streets with heavy gradients, these Meters are invaluable, as much gas is saved from the low pressure required to work them.

ALL METERS ARE UPHELD FOR FIVE YEARS.

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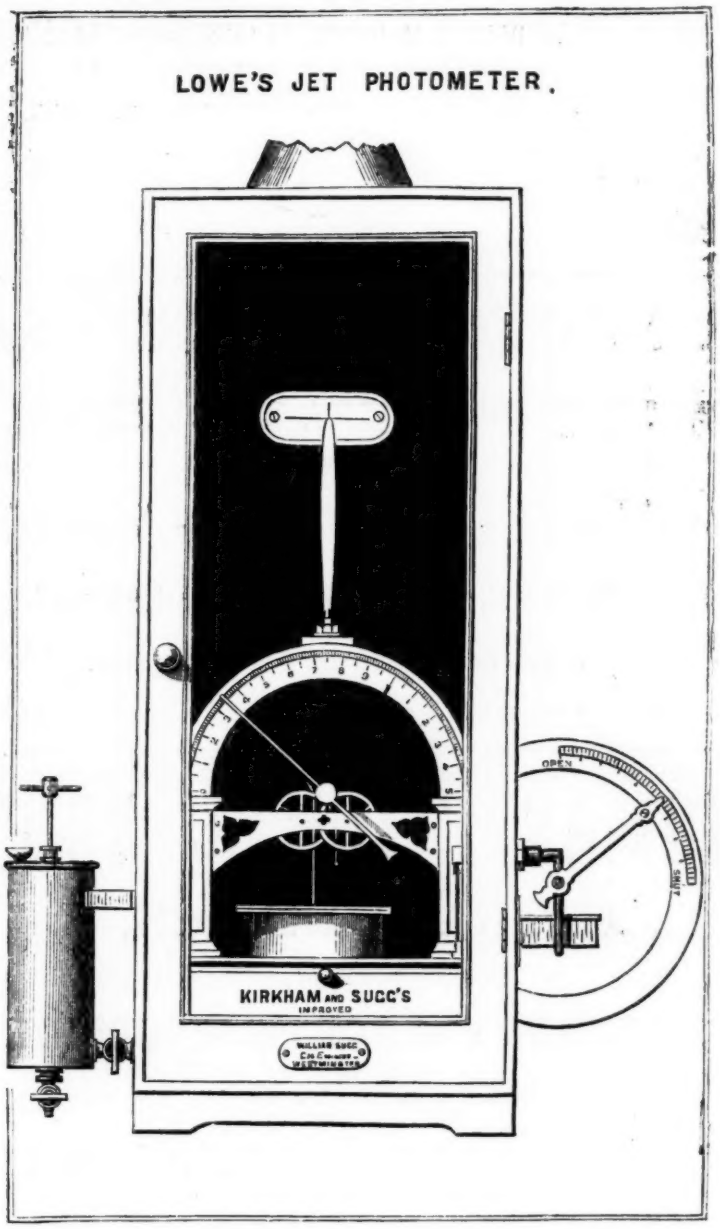
Photometers,

which do not require a Dark Room, with every Fitting accurately made to Gauge. French Polished Bench and Drawers complete, as approved by the Gas Referees.



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Photometers,

with Fittings and Bench complete for Dark Room, as approved by the Gas Referees.

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(KIRKHAM AND SUGG'S IMPROVEMENTS),

With new external Water-Line Regulator; Improved Micrometer, with Quadrant divided into 45 degrees; Valve, with *pro ratâ* opening; Improved Ventilator, Purple Glass Height of Flame Measurer; King's Gauge, working on Friction Rollers. In French Polished Pine Case. Diagram for ditto for finding the Illuminating Power in Candles.

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SUN-BURNERS,

With Regulating Valves to obviate down draught.

MEDIÆVAL & OTHER GAS-FITTINGS

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SOLE CONSIGNEES FOR BRÖNNER'S IMPROVEMENTS IN GAS LIGHTING.

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HENRY GREENE AND SON, 155, Cannon Street, London, Sole Agents for Great Britain, Ireland, and Colonies, of Brönner's Improvements in Gas Lighting, beg to inform the public that on the 13th of January, 1876, Julius Brönner obtained an injunction in the Court of Session, Scotland, against Donald M'Vean, Gas-Fitter, 14, Newton Street, Glasgow, prohibiting him from in any way advertising or offering for sale as Brönner's Burners, any Burner not manufactured by Julius Brönner, or from in any way inducing the public to believe that the said Donald M'Vean sells or keeps for sale Brönner's Burners, manufactured by Julius Brönner, while such is not the case.

Also that on the 9th of November, 1875, he obtained injunction in the same Court, and in the same terms, against R. M. Brechin and Co., 46, North Hanover Street, Edinburgh.

Also that on the 20th of April, 1875, in a suit in Chancery, before Vice-Chancellor Malins, number 1874, B 365, he obtained injunction against another defendant, in the same terms and on similar grounds.

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SOLE MAKERS OF

MORTON'S PATENT SELF-SEALING

RETORT-LIDS,

WITH

HOLMAN'S NEW PATENT

BRACKETED CROSS-BARS,

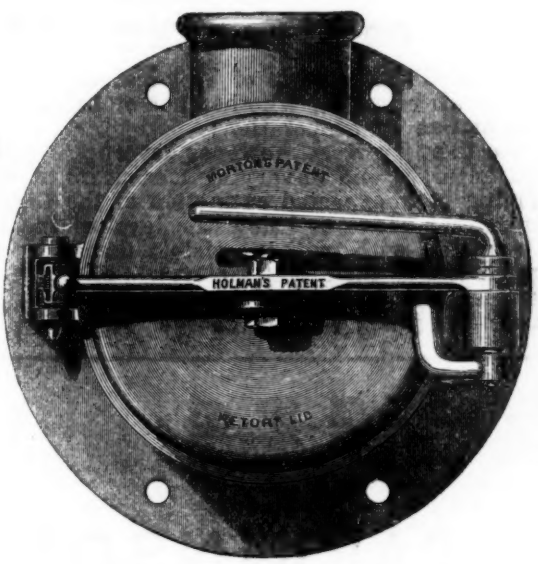
ANTI-FRICTION CATCHES, AND ECCENTRIC FASTENINGS.

NO LUTING.

NO DUPLICATE LIDS REQUIRED.

INSTANTANEOUS SEALING EFFECTED.

VERY DURABLE.



HOLMAN'S NEW SELF-SUSTAINING CROSS-BAR ENSURES FREEDOM OF JOINT, AND MAINTAINS PARALLEL POSITION OF THE LIDS.

By the employment of MORTON'S PATENT SELF-SEALING RETORT-LIDS, with HOLMAN'S PATENT ECCENTRIC FASTENINGS, the old-fashioned, cumbersome, and expensive method of sealing Retorts, by luting the lids with lime and other materials, is entirely dispensed with.

Since their introduction in 1869, these Patent Retort-Lids have been thoroughly tested, over 20,000 being in use at various Gas-Works in London and the Provinces, among which may be mentioned:—

The Gaslight Co., Beckton (where nearly 4000 are in use).
" Gaslight Co., Bow Common.
" Gaslight Co., Silvertown.
" Gaslight Co., Lupus Street.
" London Gaslight Co.
" Independent do.
" Phœnix do.
" South Metropolitan Gaslight Co.
" Commercial do.
" Imperial do.
" West Ham Gas Co.
" Gas-Works, Barnet.

The Gas-Works, Royal Arsenal, Woolwich.
" do. Lower Sydenham.
" do. Brentford.
" Consumers Gas Co., Woolwich.
" Alliance and Dublin Gas-Works.
" Edinburgh do.
" Manchester Corporation do.
" Salford do. do.
" Rochdale do. do.
" Liverpool Gas-Works.
" Birmingham do.
" Birkenhead do.
" Nottingham do.

The Newcastle-on-Tyne Gas-Works.
" Lurgan do.
" Carmarthen Gas-Works.
" Merthyr Tydfil do.
" Windsor do.
" Leeds do.
" St. Albans do.
" Over Darwen do.
" Rotherham do.
" Aylesbury do.
" Bournemouth do.
" Ystrad do.
" Cardiff do.
" Rochester do.

The Keighley Gas-Works.
" Aberdare do.
" Ballymena do.
" Richmond do.
" Stalybridge do.
" Longton do.
" Exeter do.
" Ross do.
" Falmouth do.
" Barrow-in-Furness do.
" Belfast do.
" Wakefield do.
And other Provincial and Foreign Gas-Works.

IMPORTANT TESTIMONIAL.

The Gaslight and Coke Company (Commonly called the Chartered Gas Company), Beckton, North Woolwich, July 2, 1874.

MESSRS. TANGYE BROTHERS AND HOLMAN.

Gentlemen,—In answer to your inquiry respecting the Self-Sealing Lids, I beg to say that they continue to work well, and I have every reason to be satisfied with them.

I should be very sorry to return to the old system of Luting, and our stokers here freely acknowledge the benefit to them of the new system.

I am, yours truly,
(Signed) G. C. TREWBY.

London 1851. New York, 1853. Paris, 1855. London, 1862.

Dublin, 1865 Paris, 1867.

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NOTICE TO SUBSCRIBERS.

Subscribers who desire to avail themselves of the reduction in the subscription to the JOURNAL by paying in advance for the second half of the year 1876, are reminded that this can only be done during the present month.

THE JOURNAL OF GAS LIGHTING,
WATER SUPPLY, & SANITARY IMPROVEMENT.

TUESDAY, JULY 18, 1876.

Circular to Gas Companies.

"WHERE are we now?" as the stump orator exclaims. Well, we have to report, that the prospects of gas legislation for the year are clearing, and we rather think, but it is not advisable to speak positively, that there is now a chance of metropolitan gas affairs being settled, so far as they can be settled, by legislation. The little difficulty, resulting from non-compliance with Standing Orders, having been surmounted, the Metropolis Gas (Surrey Side) Bill has been read a second time in the Commons, and is now referred to a Select Committee, nominated, as usual, in part by the House, and in part by the Committee of Selection. The names of the members appointed by the House will be found in another column. To-day the Committee of Selection will meet, and nominate the other members; but it is well understood that the Right Hon. W. E. Forster will again be Chairman. As no time must be lost, if anything is to be done this year, the Committee will commence their sittings immediately, and probably a preliminary meeting will be held to-morrow. It is not at all likely that the proceedings will be long. The opposition has so far dwindled away, that only two or three vestries on the Surrey side, whose parishes are wholly, or in part, supplied by the South Metropolitan Company, now protest. Whether or not these will put in an appearance before the committee, remains to be seen. If they take our advice, they will stay at home, and save the ratepayers money. The Government, it would seem, are determined to carry the Bill, and Mr. Forster is so completely committed to uniformity of initial price, that we do not think any advantage will be gained by a display of forensic eloquence, and a parade of expert witnesses, on the part of the opposing vestries. Thus we have to modify, to some extent, the opinion we expressed in our last "Circular," and admit there is now some possibility that further legislation, with reference to metropolitan gas affairs, will take place this session.

It becomes, then, our duty to inquire, what is the legislation to be expected. On this point we must refer to the proceedings at the last meeting of the Metropolitan Board of Works, reported in another column. It would appear that one more conference has taken place between representatives of the Metropolitan Board, the Surrey Side Gas Companies, and the President and Secretary of the Board of Trade. At this meeting the companies consented to abandon the clause relating to the acquisition of land. Until the altered Bill is printed, we must remain in doubt as to the exact extent of this concession; but it would appear to-day that the companies have, according to the report of the Parliamentary Committee of the Metropolitan Board, "agreed to omit altogether "the clause relating to the acquisition of land." This we consider unwise, for land will certainly be required by one or more of them within a few years, and it would be well to acquire sites for storeage works as soon as possible. The matter is not, however, pressing, and great changes may take place before additional lands are wanted.

On the question of amalgamation, the Metropolitan Board have given way. We reported last week that they raised a strong objection to the clause in the Surrey Side Bill, which conferred powers of amalgamation, *inter se*, among all the companies south of the Thames, including, of course, the South Metropolitan, and that they had requested the Board of Trade to modify the clause, so as to exclude the company named. We pointed out, in our last, the consequences which would probably ensue, if the wish of the Metropolitan Board were complied with. The Parliamentary Committee have, however, reconsidered the matter, and, stoically submitting to the inevitable, they now report in favour of the clause to which, last week, they strongly objected. Probably, the opinion of the Board has undergone no change, but the majority have had to resign themselves to circumstances. The letter of Mr. Farrer, written after the interview we mention, is blandly explicit. The writer points out that amalgamation is greatly to be desired in the interest of consumers; that Parliament has approved of the principle, and, he might have added, that his department have set their minds on promoting it. To-day, the question is whether there shall be one company on the south, and another on the north, or a complete amalgamation. Mr. Farrer assumes that the Metropolitan Board are in favour of two companies, and what has been called the "competition of "comparison," whatever that may mean. But we are quite certain that Mr. Farrer desires, as we do, to see a complete amalgamation, north and south. It is only with such a combination that the greatest benefit can be secured for consumers, and, moreover, general amalgamation so much smooths the way for the transfer of the undertakings to a public authority, which is inevitable before many years are past, that we are astonished to find the Board of Works favouring a dual scheme.

Of course all the dispute arises from the difference in the initial price it has been attempted, and so far with success, to fix on the South Metropolitan Company. Now, on this point, the conduct of the Metropolitan Board has not been quite consistent. Their own Bill, as it passed Committee last, and was introduced this year, proposed a uniform initial price. Why, then, should they oppose uniformity when proposed in a Government Bill? The Regulations Bill, it is true, made no reference to amalgamation; that question was left as it stood, the power of the Chartered Company to amalgamate with any or all other companies remaining. Now, when it is altogether too late, the Board threaten to agitate for a repeal of the amalgamation clause of the Chartered Company's Act. They had better now leave the gas question alone. They have spent a great deal of time over it, and, as Mr. Runtz candidly admits, have spent thousands of pounds on it every year, but the good they have done would be difficult to specify.

The question to-day is, as we have said, shall there be two companies or one? No positive answer can be given; but there would appear to be a probability that, supposing the Board of Trade Bill to pass, a southern combination may be formed under what we may call the presidency of the London Company. Preliminary arrangements, we understand, have so far progressed, that it has been settled that the London, Phœnix, and Surrey Consumers Companies will unite on equal terms, while the South Metropolitan will come under this arrangement with a guaranteed minimum dividend of 10 per cent., and a participation in all the advantages which may be derived from the upward sliding scale. This position is the only one the South Metropolitan Company could accept, with whomsoever they might amalgamate. It is nothing less than their due. If, then, the Board of Trade Bill pass the Committee without alteration, we presume that the South Metropolitan Bill will be immediately withdrawn, and thus the uniform *initial* price will be assured.

When the combination above mentioned is effected, there will also be uniformity in *selling* price also, and consumers in Camberwell may be anxious to know what the price will probably be. We have said so often that we are tired of repeating, that amalgamation in the south must necessarily be attended with a levelling-up of price. The objectors fix their attention on the initial price of 3s. 9d., and unblushingly assert that that will be the future price of gas. It will be nothing like it until another great rise takes place in the cost of coal. For the present, as we showed some months ago, gas can, and is sure to, be supplied for

very much less. Camberwell is certain, however, to have to pay more than 3s. We heartily commiserate the consumers in the South Metropolitan district. They will probably be charged some 4d. per 1000 feet more than they now pay; but, at the same time, they will have the gratification of knowing that their neighbours will pay some 2d. per 1000 less than they are now charged. This, surely, will be balm for their wounded spirits.

Accepting as a fact the report of a projected southern confederacy under the auspices of the London Company, we may inquire what is to be done with regard to the northern part of their undertaking. A "southern" combination, stretching across the river, would be a strange anomaly. We must, then, suppose that whenever a southern combination is formed, the northern part of the London Company's undertaking will pass to the Chartered Company. The ready agreement of the companies interested in the Surrey Side Bill, to the abandonment of that clause in the measure conferring power to acquire land, seems, to our minds, to show that a division of the undertaking is contemplated. Supposing the London confined to the other side of the water, no land is likely to be required for many years to come, while the Chartered Company will presently have enough to last them for an indefinite period. Before our next issue, we shall probably have learnt more of the intentions of the companies, and of the negotiations in progress. For the present, we leave the question, congratulating ourselves that one more step has been taken towards the consummation we so greatly desire to witness—viz., the concentration of the gas supply of the Metropolis in the hands of one body, and that body a commercial company. It may be said that this is not designed. That may be true at present, but when two bodies, with the same privileges and responsibilities, are formed, there can be no difficulty in welding them together. We have always been convinced of the policy, and we are now every day more hopeful of the accomplishment, of a general amalgamation.

The first quarterly report of Professor Williamson, the Chief Gas Examiner, shows that the Metropolitan Gas Companies, under his supervision, continue loyally to fulfil their obligations. It will be seen that in all cases the illuminating power of the gas supplied has been in excess, in some cases considerably so, of the statutory requirements. As regards "sulphur," the report is no less satisfactory. The difficulty seems now to be everywhere surmounted, no doubt at some cost; and it will be seen that the South Metropolitan Company's gas, on one occasion, at all events, contained—or rather, to be precise, yielded—no more than 6·7 grains per 100 feet. Ammonia has almost entirely disappeared from London gas, the small proportion allowed by the Instructions of the Referees being rarely exceeded. When all the difficulties of the manufacture are taken into consideration, the most carping critic of the doings of the gas companies—even Mr. Lowe, if he would only take a little trouble in studying the matter—must admit that, as regards the quality of the gas supplied, the companies fairly do their duty.

We said last week that Mr. John Sampson Peirce, the ex-Referee, has not, and never has had, any political or other connexion with Dover; and now we are told that there is no Mr. Peirce bearing the same baptismal names who mixes with politics in the borough.

We publish to-day the interesting discussion on the Sunday Labour question, at the recent meeting of the British Association of Gas Managers. It is a question on which we hold a very strong opinion, but we shall leave our readers to be guided by the experience of the practical men who took part in the debate.

Our old friend, Mr. Lewis Thompson, continues the publication of his little pamphlets. The last which has reached us is entitled "The Miner's Curfew, and other Matters, Social and Political." In the "Miner's Curfew," Mr. Thompson describes an apparatus he has devised for giving warning when an accumulation of fire-damp takes place in a working. We need not quote the description. The next paper, on "The Manufacture of Illuminating "Gas without the Use of Coal," will most interest our readers. Mr. Thompson would appear to believe that the manufacture of coal gas is doomed to extinction. "The days of gas nastiness," he says, "are numbered. . . . The glare, the flare, the "soot and smoke of gas-works, the stench and nuisance of the gas "tar, the gas lime, the gas liquor, &c., all proclaim, with prophetic "accuracy, that things cannot be allowed to remain as they are." The idea which has taken possession of Mr. Thompson's mind is, that the manufacture of coal gas may be superseded by the production of a mixture of nitrogen, carbonic oxide, and a little hydrogen, which is formed when atmospheric air is passed over or through a mass of incandescent charcoal, the mixture so produced being subsequently carburetted by carrying it through a vessel containing a light petroleum spirit (benzoline). Living secluded, in a Bedfordshire village, the author probably is not acquainted with the numerous inventions patented within the last few years for carrying out his idea. That every one, up to the present moment, has failed, we need hardly say. There is, we believe, a possible future for carburetted "water gas;" but, in the absence of the Lewis Thompson of twenty years ago, we despair of seeing much progress made in the practical application on a large scale of the process described in this paper. The manufacture of coal gas has the "long day," which an Irishman asks for when he is sentenced to be hanged; and the best advice we can give our readers is, to persevere in their endeavours to reduce the concomitant nuisances to a minimum.

The Rochdale Town Council have been discussing the coal and cannel contracts of the Gas Committee for the year—that is, as far as they can, for, necessarily, some reticence is observed. We learn, however, that, having put out tenders for a supply for three years, only one colliery proprietor came forward to contract for more than the current year. The others—wisely, we think—considered that the present depression of trade would be only temporary, and that, as soon as a revival took place, prices would rise. That is exactly our opinion; but, by all means let gas companies make three-year contracts at present prices, if they possibly can.

The accounts of the Metropolitan Gas Companies have just been presented to Parliament, and our usual abstract will be published as early as possible.

Water and Sanitary Notes.

It has often been urged, as a sort of reproach to chemical and medical sanitarians, that they have devoted themselves to the examination of water, which is a very easy business, to the almost utter neglect of the air we breathe, a satisfactory examination of which is a much more difficult and troublesome matter. There is this to be said, further, that the discovery of polluted air, affords no one the opportunity of attacking either a Corporation or a Water Company, and it is well understood to-day, that the easiest way for a chemist to earn notoriety is, to write a report to the newspapers, abusing a water supply. It may be that because the quality of the water supply of Glasgow is not considered so satisfactory as it once was, that the Police Commissioners of the city have turned their attention to the air, and they have ordered examinations to be made in different parts of the city, where a high death-rate prevails. The first attempts have not been successful, and no wonder. That most patient and conscientious of all experimenters, Dr. Angus Smith, has not succeeded, to his satisfaction, in determining the amount of organic matter in air. We know, however, that the quantity is relatively large. The amount of "albumenoid ammonia" taken into the lungs along with a comparatively pure air, must greatly exceed that taken into the stomach along with the worst drinking water. It has been calculated by Dr. Buchanan, that all the inhabitants of Croydon parish (63,000 in 1875) must drink a gallon of Croydon water daily for four years, before they get through a grain of albumenoid ammonia. We shall, some day, calculate how much water an inhabitant of London must drink, before he gets through a grain of "organic nitrogen," and the figures will astonish most readers. The Glasgow Police Commissioners have set a good example; and we shall wait, with much curiosity, for the report their medical officer will furnish on the organic pollution of the air of their city.

The Liverpool Town Council have held another meeting to discuss the report of the Water Committee, the greater part of which they have adopted by a large majority. By this decision, however, the Council are committed to nothing. So far, we rather think the Council have only endorsed the view of the Committee, that, in providing for the future supply, the quantity of water per head of population per day, must be calculated at thirty gallons. This being settled, the Council have to look for a scheme to fit the want. They have several before them, some complete, others still inchoate. The idea of extending the well system, finds but little favour in the Council, and the proposal to go out of their district and sink wells is certain to be rejected. If not, the population of Widnes, for example, would be sure to oppose the sinking of wells in their district for the supply of Liverpool and its out-townships, and a Parliamentary Committee would most certainly support the opposition. The debate in the Town Council is again adjourned, and, proceeding at this rate, we have a fear that no decision as to the scheme to be adopted, will be arrived at in time for the notices necessary to be published, for a parliamentary campaign next year. Supposing the Town Council to decide against an extension of the well scheme, the Water Committee have still, to select from the Bleasdale, the Windermere, the Ullswater, and, finally, the Haweswater schemes, of which last, we believe, they are not yet furnished with full details.

The Rivers Pollution Bill does not make progress, and the chance of the measure becoming law this session is rapidly passing away.

It is likely that the greater part of the measure will have to be cut away, and that, after all, it will resolve itself into an Act to prevent the casting of solid matters into streams. But even in this case a difficulty is presented. The paper makers ask for a definition of solid matter, and propose that the expression shall not include matter in a state of suspension. Simple as the demand is, a decision on the point is not to be easily arrived at. It may be that the matter is of no great importance, since the Local Government Board can always step in to prevent vexatious proceedings, acting like a grand jury, and returning no "true bill." Candidly speaking, we think that, with this provision, the Bill might be allowed to pass, for it would be entirely inoperative. Still, we believe that a great deal might be done to prevent the pollution of rivers, if the matter were fairly considered. We should look for much good from a conference between manufacturers and a competent chemist, not possessed with a "fixed idea."

We have to acknowledge the receipt of a magnificent work, entitled "A Comprehensive Treatise on the Water Supply of "Cities and Towns, with Numerous Specifications of Existing "Water-Works," &c., &c., by Mr. Wm. Humber, Assoc. Inst. C.E. The volume is of much too great importance to be disposed of off-hand, and we must, therefore, reserve a more critical notice for a future number. We have also received a small book on "Sani-"tary Work in the Smaller Towns and Villages," by Mr. Charles Slagg, Assoc. Inst. C.E., a notice of which we must also defer.

A TREATISE ON THE SCIENCE AND PRACTICE OF THE MANUFACTURE AND DISTRIBUTION OF COAL GAS.

C.

Composition and Analysis of Purified Gas.

Benzene, *Benzol*.*—It is probable that the vapours of all the bodies obtained from coal-tar naphtha are to be found in coal gas, in variable proportions relatively small. As, however, benzol constitutes the bulk of coal-tar naphtha, and is, moreover, the most volatile of the bodies present, it no doubt affords the largest amount of vapour to the gas. The amount found is very variable, but its presence may in general be proved by two direct experiments. When a current of gas is slowly passed through a U-shaped tube, inserted in a freezing mixture, benzol is sometimes condensed, and is found in the elbow of the tube. If, however, only a very small amount be present, it may be detected by passing the gas slowly through fuming nitric acid. In this way *nitrobenzol* is produced, which is deposited in the shape of a yellowish, oily liquid at the bottom of the vessel. Nitrobenzol is recognized by its possessing an odour resembling that of oil of bitter almonds. This body will be more particularly mentioned when we come to treat of the utilization of gas products.

Pure benzene is a colourless liquid, possessing an agreeable odour. It freezes into a crystalline solid at 32° Fahr., and boils at 177° Fahr. Its specific gravity at 60° Fahr. = 0·8833.

The vapour of benzol burns with a highly luminous flame, and in its impure state, as commercial naphtha, it was the first body used for carburetting or naphthalizing gas. The increased price of coal naphtha now forbids its use for this purpose; but, as showing the value of benzol in contributing to the illuminating power of gas, we may briefly mention the results of experiments made by Dr. Letheby to ascertain its worth as a carburetting agent. He found that for every grain of benzol absorbed by a cubic foot of common gas, the illuminating power was raised about 10 per cent.† Perhaps experiments made to-day with modern burners might modify these results, but the subject is now of little importance.

The vapour of benzol at the ordinary temperature and pressure has the specific gravity 2·695. It is but slowly condensed by bromine, and probably none is removed from gas when that agent is employed to determine the volume of the illuminating constituents. Fuming sulphuric acid absorbs it more rapidly.

When vapour of benzol is passed through a porcelain tube heated to bright redness, it is partly decomposed, yielding hydrogen, a little acetylene, and a condensable product of complex constitution. When the vapour is heated to dull redness with olefiant gas, the chief product is naphthaline. It is quite possible that these two reactions may take place in the retort.

The other liquid hydrocarbons, whose presence in coal gas has been either ascertained or inferred, need not be described. They can only exist in very minute quantities, for the whole of the condensable products in common gas do not exceed five per cent. of the volume, and in the richest cannel rarely exceed ten per cent. A simple enumeration of them will, therefore, suffice for our readers. They are—Toluene (C_7 H_8), Xylene (C_8 H_{10}), Mesitylene (C_9 H_{12}), Cymene (C_{10} H_{14}), Tricrotonylene (C_{12} H_{18}), Colophene (C_{30} H_{24}).‡

* The former term is now restricted to the pure body, C_6 H_6, while the latter denotes the commercial product distilled from coal tar.

† "Report to the Corporation of the City of London." (See *Chemical News*, vol. vi., pp. 283—292; and also "Proceedings of the British Association of Gas Managers for 1865," p. 34.)

‡ The presence of the two latter-named has only recently been ascertained by Berthelot. (See *post*, p. 94.) A reader who wishes for a detailed account of these bodies, and their chemical relations and derivatives, will find the best extant in the first supplement to Watts's "Dictionary of Chemistry." Longman and Co., 1872.

Naphthalene, *naphthalin* (C_{10} H_8) is a solid body, the vapour of which, fortunately when it is in small quantity, and unfortunately when the amount is large, travels with gas beyond the purifiers. In the one case it greatly adds to the illuminating power of the gas, and in the other is liable to produce obstructions in the mains and service-pipes, which lead to serious inconveniences. When pure, naphthalene is a crystalline solid, consisting of snow-white flakes, which melt at the temperature of 174° Fahr., the liquid boiling at 428°. The reactions and decomposition of hydrocarbons which may take place in the retort, and result in the production of naphthalene, may be said to be multitudinous. Some is probably produced when any hydrocarbon is broken up under the influence of heat. Berthelot, for example, has ascertained that the vapour of toluene, when passed through a red-hot tube, breaks up into naphthalene and benzene; xylene, again, under similar circumstances, yields naphthalene and toluene, and cumene furnishes naphthalene and xylene. Under like circumstances, the decompositions of mixtures of the vapours of benzene, cimamene, anthracene, and chrysene with olefiant gas, all result in the production of more or less naphthalene. It must be observed that this body, when formed, is remarkably stable. According to Berthelot, it undergoes no change at a red heat, and is but slightly altered when heated with hydrogen. At a bright red heat, however, its decomposition is said to yield small quantities of benzene and acetylene.

The fact has been satisfactorily ascertained that naphthalene is produced in the largest quantities when very high heats are employed in the distillation of coal, and the researches and experiments of Berthelot fully support the statement. To a certain extent, therefore, the amount produced is under the control of a gas manager. If it could be retained in a state of vapour, naphthalene would be one of the most valuable constituents of gas; but, unfortunately, at very high heats, most of the vapours of liquid hydrocarbons are decomposed, and but little remains to keep the naphthalene in gaseous solution; hence its speedy deposition at the smallest change of temperature. There is another cause for its deposition, which may as well be alluded to here, and that is what is called "shock." A sharp angle in a service-pipe is very apt to become choked by naphthalene. Friction, also, has much influence in withdrawing it from solution, for long lengths of small pipes are very apt to be stopped by its deposition, especially when exposed.

The vapour of naphthalene at the ordinary temperature and pressure has the specific gravity of 4·422. It is easily condensed by bromine, and also by fuming sulphuric acid. From its richness in carbon it burns with a bright flame of great illuminating power, and hence the Rev. W. R. Bowditch has proposed to employ it as a light-giving agent. The apparatus which the reverend gentleman has devised for its employment for the purpose will be found described in his work on the "Analysis, &c., of Coal Gas."

There is another point with reference to naphthalene, referred to by Mr. Bowditch, which may be mentioned here, though somewhat out of order. Naphthalene is a great carrier of sulphur, and probably the sulphuretted hydrocarbons, which we have good reason to believe exist in gas, will be found to be compounds of sulphur with naphthalene. Faraday has, in fact, described two such compounds, and others may possibly be discovered.

The other solids, whose vapours may, perhaps, be found in purified gas, are anthracene, chrysene, and pyrene, the composition of which bodies has been referred to in an early part of the "Treatise," and need not be mentioned here.

We may stop to express a regret that no systematic study of the generation of gas products has ever been attempted in this or any other country. It would seem a simple matter—it is certainly not a difficult one—to commence the distillation of coal at a low temperature, and make a complete investigation of the condensable and gaseous products obtained; and so, passing on to the highest available heats, ascertain the exact stages at which the luminous, non-luminous, and what we may call deleterious ingredients are produced. A careful research of this kind would teach us much that might lead to great economy in manufacture, and possibly to great economy in consumption.

Passing for a time an account of the impurities commonly found in gas as distributed, we come to the means of ascertaining its value. The first of these is the determination of its specific gravity, the methods for estimating which will be next described.

(To be continued.)

North Shields Water-Works Company.—The annual meeting was held on the 10th inst.—Mr. J. Ridley presiding. The directors report stated that since the last annual meeting 119 services had been laid on to supply 171 new consumers. The gross revenue for the year was £6828 11s. 1d., and the expenses £4446 13s. 2d., leaving a balance of £2381 17s. 11d., which, with £26 1s. 4d., the balance after paying the dividend last year, made a total of £2407 19s. 3d. to the credit of profit and loss account. Out of this sum the directors recommended a dividend of 5 per cent., which amounted to £2000, to which must be added the sum of £54 11s. 2d. due to the Duke of Northumberland, being his one-seventh share. After paying these amounts there would be a balance of £353 8s. 1d. to the credit of profit and loss account. The chairman moved the adoption of the report, which was seconded by Mr. Taylor, who inquired what amount of storeage for water they were possessed of, as he had heard that the company were unable, through want of storeage, to take advantage of surplus water during the wet season. The chairman, in reply, stated that the reservoirs at present were pretty well filled, and, therefore, they did not require further storeage. The works at Billy Mill were not yet completed, and it was not known whether they would require any further reservoirs. There was a large reservoir underneath at Billy Mill, and it had never been put to the test so as to see what quantity of water they could attain, and which could not be done until the permanent pumps were put down, which would be done by the autumn of this year. The report was adopted, and the directors appointed. A vote of thanks to the chairman terminated the meeting.

Correspondence.

CALCULATION OF COST PRICE OF GAS TO PUBLIC LAMPS.

SIR,—Under this title, your correspondent, "R. A. G." invites remarks on his statement of expenses in the manufacture of gas.

Being manager of works of a very similar size to his, this statement has much interest for me, and I trust he will pardon my making a remark or two upon it.

The first item which puzzles me is the charge of £29 5s. 1d. for "general expenses." Lime is the only thing that "R. A. G." seems to have omitted, which may be included under this heading, but surely it cannot amount to such a sum as that. I should have thought £18 sufficient. The next charge is £96 19s. 2d. for repairs. This must be a mistake, I think; he must have charged to one year what ought to have been spread over several. At all events, my repairs do not cost one-third of that amount!

Taking £75 as the difference in those items between the actual cost and that charged, this will make a deduction of 7d. per 1000, lessening the cost of manufacture to 5s. 6d., which ought not to be exceeded.

ANOTHER MANAGER.

GAS ANALYSIS.

SIR,—It is possible that many of our gas friends, taking advantage of the long days and fine weather, are presently out on holiday, getting their lungs purified from bad vapours by bracing sea or mountain air, and if so, no one can grudge them the enjoyment. But whether or no, I would beg leave to observe that the questions I submitted to your readers on the subject of "Gas Analysis" in the JOURNAL of the 13th of June, have remained till now unanswered. Unless they are shown to be erroneous, I shall hold myself entitled to conclude that the objections I stated in reference to the usual mode of *calculating* candle power by public analysts to something different from the indications of the photometer is radically wrong, and ought to be abandoned. Were some of the Gas Referees or other recognized authority to take and clear up this matter, they would render a useful service to gas managers throughout the country besides

A. MICAWBER, Jun.

Glenmutchkin Gas-Works, N.B., July 13, 1876.

THE THEORY OF RETORT-SETTINGS.

SIR,—Will you kindly allow me, through your JOURNAL, to express my opinion on one part of Mr. Richards's paper "On the Theory of Retort-Settings?"

I beg to state at the outset that I have read the above-named able paper with interest and pleasure; but as there is one point which is at variance with my experience, I ask the liberty to make the following remarks:—

Furnace Construction.

The writer says that a furnace for a setting of eight retorts, carbonizing 3 tons of coal per day, should be of the following dimensions, viz:—The opening at the fire-bars 3 feet 6 inches long and 10 inches wide. The furnace, he says, should besplayed out to one-third its opening, so that would be 13⅓ inches; also it should be twice its width in depth, which would be 2 feet 2⅔ inches.

Now, in my experience, I find that the above size is unnecessary, and if adopted, would be attended with considerable waste of fuel, even in coal furnaces.

The following is the size of furnace which has been adopted at these works for several years for settings of eight retorts 16 inches diameter and 9 feet long, carbonizing 4 tons of coal per day:—The opening at the fire-bars is 2 feet 8 inches long and 5½ inches wide, splayed out to 14 inches, and the depth from crown of arch to fire-bar 1 foot 10½ inches; when the bars are deducted, the air space is 98 inches. But we have a supply of hot air round the top of the furnace, which is equal to 25 inches, making, in the total, 123 inches, which is amply sufficient.

The small furnace obviates the overloading with coal in firing, and thereby effects an important saving in fuel.

Permit me to make a few remarks as to the hot air, because, in my opinion, no coal furnace is properly constructed without such arrangement. Some objection has been taken to the system, on the ground that the heat was taken from the side of the furnace; but such objection only holds good to a very limited extent, as the heat which is taken up mechanically from the side of the furnace bears no comparison to the heat which is raised in the top of the furnace by the chemical reactions of the oxygen with the carbonic oxide and the various hydrocarbons.

I am sorry that I did not hear that part of Mr. Richards's paper at the meeting, and had not an opportunity of expressing my opinion upon it there.

JOHN TINDALL.

*Gas-Works, Walsall, July*15, 1876.

Parliamentary Intelligence.

HOUSE OF LORDS.

MONDAY, JULY 10.

The Stockton and Middlesbrough Corporations Water Bill was reported from the select committee, with amendments.

The Kirkcaldy Burgh and Harbour Bill was read the third time, with the amendments, further amendments made, and bill passed.

A petition in favour of the Cleveland Water Bill was presented from Inhabitants of Hinderwell, &c.

TUESDAY, JULY 11.

The Newcastle and Gateshead Water Bill was reported, with amendments.

The Sevenoaks Gas Bill was reported, without amendment.

The Lancaster Water and Improvement Bill was read the third time, with the amendments, and passed.

THURSDAY, JULY 13.

The following bills received the Royal Assent:—Gas and Water Orders Confirmation (Chapel-en-le-Frith, &c.), Huddersfield Water and Improvement, Kildwick Parish Gas, Paisley Water, Whitehaven Harbour and Town Improvement, Uppingham Water, Bristol United Gas, Walsall Gas Purchase and Borough Extension, Rosstrevor Improvement, Blackrod Local Board, Sutton Gas, Redcar and Coatham Gas, Southport Improvement, Spennymoor and Tudhoe Gas, Horncastle Gas, Southampton Gaslight and Coke, Colney Hatch Gas, Tipton Local Board, West Bromwich Improvement.

The Oldbury Local Board of Health and the Cleveland Water Bills were read the third time, with the amendments, and passed.

BURGHS (SCOTLAND) GAS SUPPLY BILL.

On the order of the day for going into committee on this bill,

The Earl of GALLOWAY said he had received a great many suggestions since the second reading of the bill with reference to various clauses, and he would simply move that the House should go into committee *pro formâ* on the bill, in order that it should be reprinted.

The bill passed through committee *pro formâ*, and was ordered to be recommitted for Thursday, July 20.

FRIDAY, JULY 14.

The Newcastle and Gateshead Water Bill was read the third time, with the amendments, and passed.

HOUSE OF COMMONS.

MONDAY, JULY 10.

The Lords amendments to the Colney Hatch Gas Bill were agreed to.

A petition against the Metropolis Gas (Surrey Side) Bill was presented from Lambeth.

TUESDAY, JULY 11.

The Lords amendments to the Tipton Local Board and the West Bromwich Improvement Bills were agreed to.

The following resolutions, reported from the Standing Orders Committee, were agreed to:—"That in the case of the Metropolis Gas (Surrey Side) Bill the Standing Orders ought to be dispensed with."—"That the bill be permitted to proceed."

WEDNESDAY, JULY 12.

The Blackrod Gas Bill (Lords), as amended, was considered; to be read the third time.

PURIFICATION OF THE THAMES.

On the motion of Mr. SCLATER-BOOTH, a copy was ordered of statement of the result of the notices served by the Conservators of the River Thames, under the Thames Conservancy Acts, for the discontinuance of the passing of the sewage or any other offensive or injurious matter into the river above the intake of the water companies supplying the Metropolis.

METROPOLIS GAS (SURREY SIDE) BILL.

A petition against this bill was presented from Camberwell.

On the order of the day for the second reading of the bill,

Mr. WHITWELL called upon the President of the Board of Trade to give some explanation of the bill. He added that he did not know what it meant at all.

Sir C. ADDERLEY said it was a hybrid bill for the purpose of regulating the gas companies on the southern side of the Thames, and putting them under the same conditions as the northern gas companies, which were regulated by a bill which had nearly passed through Parliament. It was promoted by the Metropolitan Board, the Corporation of London, and the Board of Trade, and he hoped it would be allowed to be read a second time, and then referred to a select committee.

The bill was then read a second time, and referred to a select committee of five members, three to be nominated by the House, and two to be nominated by the Committee of Selection. And it was ordered that all petitions presented against the bill be referred to the select committee on the bill, provided such petitions are presented one clear day before the meeting of the committee, and that such of the petitioners as pray to be heard, by themselves, their counsel, or agents, be heard upon their petitions, if they think fit, and counsel heard in favour of the bill against the said petitions. That the committee have power to send for persons, papers, and records. That three be the quorum.

THURSDAY, JULY 13.

The Lords amendments to the Campbeltown Burgh and Harbour, the Dunfermline Water, and the Smethwick Local Board Bills were agreed to.

FRIDAY, JULY 14.

The Lords amendments to the Kirkcaldy Burgh and Harbour and the Tunbridge Wells Gas Bills were agreed to.

METROPOLIS GAS (SURREY SIDE) BILL.

Petitions against this bill were presented from the Metropolitan Board of Works and the Crystal Palace District Gas Company.

Sir CHARLES ADDERLEY gave notice that on Monday, July 17, he would move—"That Mr. Garnier, Mr. Goulding, and Mr. Stevenson, be nominated members of the select committee."—"That the minutes of evidence taken before the committee on the Metropolis Gas Companies Bill, the Commercial Gas Company's Bill, and the Imperial Gas Company's Bill, in 1875, be referred to the committee on the Metropolis Gas (Surrey Side) Bill of the present session."

HOUSE OF LORDS COMMITTEE.

THURSDAY, JULY 6.

(*Before Lord* BLACHFORD, *Chairman; Earl* COWPER, *Earl* CLARENDON, *Earl* NELSON, *and Lord* DIGBY.)

THE GASLIGHT AND COKE COMPANY BILL.

Serjeant SARGOOD, Mr. RICHARDS, Q.C., and Mr. BROUGHTON appeared for the promoters; Mr. CRIPPS, Q.C., and Mr. PHILBRICK, Q.C., for the Metropolitan Board of Works, petitioners against the bill.

Serjeant SARGOOD, in opening the case, said the company by whom the bill was promoted found themselves opposed only by the Metropolitan Board, and that opposition was directed not to any question affecting the interests of the consumers of gas in the Metropolis, but to a matter concerning the Board themselves—viz., the proposal in the bill to take a piece of land adjoining the works of the company at Beckton, which was the property of the Board. The bill contained 75 clauses, but it was only upon clauses 5 and 6 that the opposition arose. The object of the bill was one for the improvement and alteration of the present parliamentary gas arrangments in the Metropolis, and in order that that object might be conveniently placed before the committee, he would venture to occupy a few moments in giving their lordships a review of past gas legislation, so that they might understand the existing state of affairs, and the changes it was proposed to introduce. The learned counsel having given a sketch of the history of the Chartered Gas Company, and glanced at the various Acts of Parliament affecting the supply of gas in the Metropolis down to the close of last session, referred to the amalgamations that had taken place this year, and the arrangements come to between the promoters and the Board of Trade and Metropolitan Board, under which, with the exception of the one point in dispute, the bill was presented to Parliament as an unopposed measure. He then proceeded to point out the position of the Beckton works, and that of the outfall sewer of the Board, indicating the piece of land which was the bone of contention between the parties. For the purpose of his argument, he said he should deal with the company as though, to a certain extent, like the Metropolitan Board, they were a public body, discharging public duties, because they were now in the nature of competitors for convenience in carrying out, not private interests against public duties, but *quasi* public duties against public duties. The position of the company was, therefore, very different from that, say, of a railway, which came to ask for land merely for the purpose of aggrandisement,

but without any obligation to carry out anything upon the land when they had acquired it. The gas company stood in a somewhat different position, because, as he need hardly remind the committee, there was a parliamentary obligation upon them to manufacture and supply gas, whereas there was no obligation upon a railway company to construct a railway, however urgent the necessity might have been shown to be, when the concurrence of the Legislature was obtained for the compulsory purchase of the land. Of course, if a railway company having obtained such powers, did not proceed with their undertaking, those powers lapsed after a certain time; but there was no obligation upon them for all time to enlarge their railway, unless they chose. With this gas company, however, the position of things was different. As a condition of the privileges given to them by the Legislature, they had imposed upon them the obligation to supply gas to any one in their district who required it, and subject to certain limits, and under certain regulations, they might be called upon to lay mains and furnish a supply of gas into new streets and districts for the lighting of the public lamps and the use of private consumers. When, therefore, a large company like this was placed under such conditions, and the supply of gas was no longer a matter of choice, but of parliamentary obligation, they were bound to keep pace with the times, and they must have the requisite land to increase their manufacturing plant, as the increased demand was made upon them. The promoters were, therefore, in this position—for many years a public agitation had been going on to obtain the removal of gas-works, as a nuisance, out of the Metropolis as far as possible, and the result of it had been that they had been driven down to their present site at Beckton, a bare, marshy district, inhabited by no one, and where their operations could not possibly be a nuisance or annoyance to any one. There, under the auspices of Parliament, an enormous establishment had grown up, in which a million tons of coal a year were carbonized at the present moment—a consumption which would go on increasing year by year. To prepare for these increasing demands, the company were desirous of obtaining more land, and one piece which they asked for in their bill, adjoining their existing works, belonged to the Metropolitan Board, who now resisted their application, as he thought, somewhat ungraciously, on the ground that they themselves might hereafter require it for purposes connected with their sewerage works. There was, however, a little history belonging to this piece of land, with which their lordships should be made acquainted. When the Board themselves applied to Parliament last session for power to construct gas-works in competition with this company, they actually scheduled this piece of land as the site of their intended works. They did not prosecute their bill, but they admitted, when they were desirous of becoming gas manufacturers themselves, that this land, which they now said was unnecessary for the company, was essential to them. Notwithstanding they now alleged this land to be so essential to their sewerage scheme, it appeared that for many years past it had been let by them to a company, and it was only owing to the failure of that company that the land had come back again into their hands. If the company had been successful, it was certain the Board must have carried on their operations without it. In the first place they parted with the land for a good many years in prospective; next, when, through the company to whom they let it coming to grief, the land came back again into their hands, they scheduled it for gas-making purposes, and now that the promoters wanted it, they started up and said it was indispensable for sewerage purposes in the neighbourhood of their outfall works. When the bill was in the House of Commons, they only stated that this land "may probably be required in connexion with the main outfall at, or near, Barking Creek." They now stated that they "will, for such purpose, require the scheduled land." The whole length of frontage to the river of this land was 980 feet, and no doubt some amount of frontage might be convenient to them. The gas company also required additional river frontage for the purpose of facilitating the loading and unloading of coals and other materials at their works. The Board could obtain the frontage they required further eastward down the river, but the company could not get there by reason of this intervening land. The sewage of the Metropolis might be carried to any extent down the Thames, and he dared to say it was no secret to their lordships that although parliamentary sanction had been given to the throwing of the whole of the sewage into the river at Barking, the nuisance had become so much greater than was contemplated, that the Conservators of the Thames at one time found the channel of the river being blocked up by the sewage deposited from the outfall works. The Thames Conservancy Act of 1870 provided for the removal of such deposits, and looking to the rapid increase of the Metropolis, it could not be doubted that the time would come when the Legislature would declare that it was no longer convenient to allow the Metropolitan Board to pollute the river by the discharge of sewage at Barking Creek, but would compel them to go further off with their outfall, and eject the filth of their sewers at a point nearer the sea. Without, however, anticipating the future, he merely submitted to their lordships that it was not to be conceded to the Board that they had a prescriptive right to pollute the river at this point for all time to come. The question in dispute at the present time was whether the promoters of this bill could show that in the interests of the public, and in the discharge of their duties, they had a permanent claim to obtain possession of the land which their opponents said they might hereafter require for their own purposes. This was the broad issue, but then there was a narrower issue—could they possibly want it all. When the bill was before the committee of the House of Commons, the suggestion was made by the chairman that 100 feet of frontage should be reserved to the Metropolitan Board, for the purpose of enabling them to duplicate their sewer outlets if necessary, and so put an end to further discussion. Without conceding the point of such expediency, the gas company were willing to fall in with that arrangement, but the petitioners objected, and retired from the discussion in order to save their *locus standi* in this House, and he (Serjeant Sargood) hoped to convince the committee that even this 100 feet of frontage ought not to be reserved to them. He deeply regretted that the offer then made was not accepted by the Board, and thus the necessity of appearing before this committee prevented.

The Hon. *Rickard Howe Browne*, the governor of the company; Mr. *G. C. Trewby*, engineer at Beckton; and Mr. *H. Brothers*, engineer of the western division of the company's works, were then examined in support of the bill, and repeated in substance the evidence given by them in the House of Commons committee as to the extent of the company's operations, and the importance of the acquisition of the land in question for future extensions.

The following additional evidence was called:—

Mr. *W. Haywood*, examined by Mr. RICHARDS.

I am engineer to the Commissioners of Sewers of the City of London. In 1851 I assisted Mr. Frank Foster in the preparation of plans for the interception of the sewage from the districts north of the Thames. The present northern outfall at Barking Creek was then selected by me. In 1854, in conjunction with Sir J. Bazalgette, I prepared a plan on the same principle, but largely extended, for the main drainage of the northern side of the Metropolis, and I again selected Barking Creek as the best place for the discharge of the sewage. Being fully conversant with the construction of the existing reservoirs and outfall works, and the way in which they are worked, I feel certain that, unless the whole sewerage system of London is altered—which, I think, in the course of years, very probable—there will be additional storeage reservoirs needed to meet the increasing demand of the population. Supposing, however, this to be necessary, the Board have other land beside the piece in question in this case, upon which they could carry out those extended works. [Witness pointed out the Board's land on the map.]: The area to the north of the existing reservoir is something like double the area of the existing reservoir, equally available for the purpose, and presenting no difficulties in the way of its application to the purpose. If an additional outfall were provided for a second reservoir between Barking Creek and the present outfall, there would not be any risk of the outflow being carried along the Creek to the annoyance of the people living inland, as was suggested in the House of Commons. It would mingle with the present discharge, and flow in the same line of current. There are hundreds of acres of the same character of land beyond their own land and equally suitable, which they could obtain if necessary.

Cross-examined by Mr. PHILBRICK: In order to make the land to the north of the present reservoir available, the outfall would have to be more extended, but that is a mere matter of expense. At present, the land is under water at every tide—it is a reed bed—and would have to be reclaimed. No doubt there were considerable difficulties in carrying out the present outfall sewer, on account of the extremely bad foundations; but they have made the structure so complete that they could now construct an additional outfall under the existing one. For various reasons, I should prefer a new outfall, although when completed the other would be quite as efficacious and useful. Supposing it should ever be determined to separate the solid matters from the liquid before allowing the latter to flow into the river, a large tract of land would be required for the purpose; but, in my opinion, it will never come to such an arrangement with regard to sewage. Most persons, in any profession, consider the sewage system generally as a great failure; it is not the fault of engineering, but the whole system is wrong. The discharge from the present outfall sewers at Barking takes place slightly before the ebb tide, and is continued for four hours. If the outfall were taken further down the river, they would have to wait a little later, till the tide turned, before commencing the discharge. The selection of Barking for the outfall was determined by the rate of inclination at which the sewer could be laid, so as to get the necessary rate of flow, and the relation of the outfall there to the low water line. It was a most desirable outfall, no doubt.

Re-examined by Mr. RICHARDS: A river frontage is indispensable for outfall purposes, but not for the purpose of a reservoir. If the new reservoirs are not built on the land which the gas company want, the Board of Works will have to construct a somewhat larger and longer outfall sewer. There will be no other difference whatever.

Mr. *John W. Barry*, examined by Mr. BROUGHTON.

I am a civil engineer, carrying on business at Westminster, and have had considerable experience in the construction of works. I have visited the land in question, and have examined the sewerage works of the Metropolitan Board. I have read the evidence given by Sir Joseph Bazalgette when this bill was in the House of Commons. It is quite obvious to me that the gas-works at Beckton will have to be enlarged, and it is indispensable that the company should have more river frontage. If they are allowed to acquire the land in question, it will not affect the present outfall sewer in any respect, as it lies wholly to the eastward of that property, and any new reservoir required could be constructed to the northward of the existing one. The present outfall is an aqueduct, built on brick arches, 17 feet wide, the foundations going down 20 feet below ground. There would be no difficulty whatever in making a fresh outfall sewer underneath one or two of those arches.

Cross-examined by Mr. PHILBRICK: The construction of a new reservoir to the north of the present one would involve a mere matter of expense in relation to the outfall. Provided you get the space to put it on, it does not matter at all where it is.

Mr. *F. J. Bramwell*, examined by Serjeant SARGOOD.

I am a civil engineer, and a member of the Institution of Civil Engineers, and Past President of the Institute of Mechanical Engineers. I have visited the Beckton works on more than one occasion, and know the land the company seek to acquire from the Metropolitan Board, on the western side of the existing reservoir and the eastern side of their own works. If the Metropolitan Board want a larger reservoir, and an increased number of outlets into the river, they can carry out their object without using this land. They can construct a new reservoir to the north of the existing one, or they can double the capacity of the latter, which, for the probable requirements of the Metropolis, is looking a long way ahead. No doubt Sir Joseph Bazalgette exercised a very sound discretion with reference to future requirements in taking the 150 acres the Board possess for the purpose. As to a new outfall, the Board could obtain it by going to the east of their present reservoir, and between that and the west side of Barking Creek, through the reed bed, or by going through the existing reservoir. In an engineering point of view, either of these plans is perfectly feasible. It is, after all, only a question of expense.

Serjeant SARGOOD: One cannot lose sight of this, that with regard to expense or economy, whichever way you choose to put it, the public must pay the expense of conveying away their sewage, if they do not wish to be bothered with it in the Metropolis; and the public must pay the cost of gas, whether it is cheap or dear, if they will insist upon having it made at Beckton?

Witness: You cannot look at the Beckton works now as a private undertaking, they must be looked upon as a metropolitan undertaking; and it seems to me to matter very little which of the two establishments expends the money.

Serjeant SARGOOD: The public must pay in some way?

Witness: It has to be paid for in meal or malt.

Examination continued. The most obvious mode of making a new outfall would be to make it on the west side of the existing reservoir. Allow a strip of a few feet wide for the purpose, and then every difficulty vanishes. I have heard that that suggestion was made in the House of Commons. I should say a maximum of 100 feet would be sufficient—it would be a few feet more or less. Or a new outfall could be made under the existing sewer without disturbing that at all, as it is built on arches, having a clear width of 17 feet each. In my judgment it is essential that the gas company should have the land in dispute. They have utilized, in the most advantageous way imaginable, the whole of their existing river frontage, and require more. Speaking as a mechanical engineer of very considerable experience, I do not know what they have left undone, or how they could improve their present mechanical contrivances. My belief is, that the acquisition of the land asked for can be allowed to the company without detriment to the public service in reference to the sewerage works; and it is my belief, also, that it is the duty of the company, as representing the largest gas undertaking in Europe, to look forward and prepare for future requirements. They are now only looking forward for about 10 or 12 years.

Cross-examined by Mr. PHILBRICK: If it had been a question of some small undertaking, seeking to acquire land from a public body, it would be a very different thing from that of a company whose concerns have become so enormous as to be fairly regarded as a public institution.

Serjeant SARGOOD said this closed the promoters case.

On behalf of the Metropolitan Board, Mr. CRIPPS said he would call his evidence before addressing the committee.

Sir *Joseph Bazalgette* was accordingly examined at some length as to the nature and extent of the northern sewage outfall works, and the importance of the Board retaining the land which the company seek to acquire, for the future exigencies of the effectual drainage of the Metropolis.

FRIDAY, JULY 7.

Mr. *Baldwin Latham* was the first witness called this day, and his evidence went to the inexpediency of the Board parting with the land in view of the necessity for extending their sewerage operations, and the possibility of hereafter having to deal with the sewage when it arrived at the outfall, which, in his opinion, could not advantageously be taken farther down the river. He did not think this small piece of land could be of any value to the gas company compared with the large acreage they had already got, but it was invaluable to the

Board, compared with the small acreage at their command, for the purpose of dealing with the sewage of the Metropolis. There were plenty of other places where the gas company could go and manufacture their residual products, which was all that it was intended by them to use this land for.

Mr. *T. W. Keates*, consulting chemist to the Board, was next examined, and corroborated the evidence of previous witnesses on the sewerage question. As to the object of the company in obtaining the land, he thought the proposed manufacture of residual products might as well be carried on elsewhere.

Mr. *G. W. Stevenson*, examined by Mr. PHILBRICK.

The Chartered Gas Company acquired 150 acres at Beckton in 1868, and have utilized 88 acres. The Metropolitan Board have 77 or 78 acres of land adjoining, of which the company propose by this bill to take 24, leaving them only 54 for all their purposes, including the site now occupied by the outfall reservoir and the embankment of the sewer. The company have still 55 acres not utilized, in addition to the land occupied by railways and things of that kind. In this bill they have scheduled 49 acres north of their railway, 139 south of their present works, besides the land belonging to the Board on the east side. This includes 1300 feet of additional water frontage, which duplicates their present water frontage. Their existing works are capable of producing 27 million feet of gas per day, so that they have 3 acres of land for each million feet of gas made. In my judgment this is more than usual. From 2 to 2½ acres are ample. These 3 acres include a quantity of ornamental ground. There is a clock tower on the works, and a large open space around it. The works have not been laid out at all economically as to land. I do not mean to say they have not been well laid out, but not economically. The increase in their manufacture has been about 10½ million feet of gas per diem in each year since 1868. The Beckton works were not established simply to meet the increased demand, but to supply gas in place of the disused works at Curtain Road, Brick Lane, Blackfriars, and Westminster, but the actual increase in the company's business has been 10½ million feet per diem, which multiplied by 3 acres per million gives 31½ acres as the quantity which the company have utilized out of the 150 for purely increased business, leaving 56½ acres to supply the superseded works. The Imperial Company, being restricted from increasing their make of gas at Fulham and Pancras, obtained an Act of Parliament in 1869, under which they purchased 150 acres of land at Bromley suitable for gas-works purposes. They paid £90,000 for it, and laid out their works to produce in the first instance 20 million feet of gas daily, leaving space for the erection of works for another 10 million per diem. That included a dock and wharfage, and everything required for such works. That company are now amalgamated with the Chartered Company, but there is no reason—quite the contrary—why these works should not go on. The Beckton and Bromley works are not at present connected by a railway, but they are to be. The Commercial Company amalgamated with the Ratcliff Company last session, and obtained power to acquire a very considerable area of land immediately adjoining the Imperial works at Bromley, it being represented to Parliament that it was a proper site for gas-works, being surrounded by nuisances of all kinds, worse than gas-making. If a railway connects the Bromley and Beckton works, coal can be landed at the latter place for the supply of Bromley, and that would give the company sufficient land to carry on their works for 20 years to come. Up to the present time only 5 million feet of gas a day have been made at Bromley. The works are nearly completed for another 5 million. Taking the usual rate of increase in the consumption of gas, the make at Beckton twelve years hence will be about 43 million per day in midwinter. The lands in possession of the company at the present time are more than sufficient for that time, and they do not need to acquire any more. As regards wharfage, they are limited at present, but when they get the additional 1300 feet river frontage now asked for, I cannot conceive they can require any more. Undoubtedly the land they propose to acquire from the Metropolitan Board would be very convenient for the manufacture of residuals, but I do not think it would be more convenient than taking them to some central point on their present works and utilizing them. It being certain that the Metropolitan Board will require the land before many years have passed, it seems hard to take it from them, and it is not necessary the company should have it. I think it would be unadvisable for the company to make their own retorts. No other company do so; the Wolverhampton Company tried it some years ago, but gave it up; I suppose they found it did not answer.

Cross-examined by Serjeant SARGOOD: I have never advised the company, they have skilled officers of their own; but I know their works thoroughly, and I know their business, which has been admirably improved under the present management. If called in, I could so advise them in the laying out of their works as to avoid the necessity for taking this land, and I am sure they can themselves. I have never heard it stated that it was absolutely necessary for them, only that it would be convenient to have it.

Mr. *H. Woodall*, examined by Mr. PHILBRICK.

I am gas engineer to the Corporation of Leeds, and have had the management of various gas-works for 13 years. At Leeds, in midwinter, we make 6 million feet of gas per day. We manage to do that on 5 acres of land—*i.e.*, we are making 6 millions on our present site. I am laying out new works upon another site, which contains but 5 acres, and I contemplate making 2½ millions there, which will be 2 acres per million. I have heard Mr. Stevenson's evidence, and have considered the question of the company taking the land belonging to the Metropolitan Board. If they get the additional land asked for in their bill, I consider there is no necessity for their taking the piece belonging to the Board.

Cross-examined by Serjeant SARGOOD: I do not put these works on a par with ours at Leeds. The surrounding circumstances are not all different. Our works are central with reference to the supply; these are isolated, on marshy ground, and far from the Metropolis. So far the cases are not parallel. We employ about 500 men. I am not aware that the Chartered Company have to find places for their 2000 men to live in.

Mr. *H. E. Jones*, examined by Mr. PHILBRICK.

I am a civil engineer, and am joint engineer, with my father, of the Commercial Gas Company. Before that I was engineer to the Ratcliff Company, and previously to the Wandsworth Company. I am familiar with the requirements of gas companies as to land. The average land required per million feet of manufacture has, in my experience, never exceeded two acres; more commonly, much within two acres. I have prepared a table of the amount of land which is occupied by the Commercial Company at their Stepney station and their Wapping station, by the late Imperial Company, and at the Haggerston station of the Independent Company, and I have to add that we have only just completed the new works of the Commercial Gas Company, which will manufacture 12 million cubic feet per day on 20 acres of land.

The following table was handed in:—

The Gaslight and Coke Company.

	Area Occupied.	Maximum Daily Power Produced.	Area per Million.
	Acres.	Million Feet.	Acres.
Commercial Company, Stepney station . .	7¼	4·3	1·61
,, ,, Wapping station . .	2¼	1·5	1·50
Late Imperial, St. Pancras	9¾	5·58	1·64
,, Shoreditch	12½	5·79	2·15
Late Independent, Haggerston	6¼	3·5	1·72
And witness has only just completed designs of new works for the Commercial Gas Company, which will produce, when completed . . .	20	12·0	1·66

In laying out our own works, I have not been hampered by any restrictions as to space; it was a matter of choice. In fact, I find the buildings at Beckton need not occupy the space they do—they are dropped about on the ground in a way which is incomprehensible to me. I do not know, as a manufacturer, what they want all these spaces for—the space between the meter-houses and the purifiers, for instance. The works are laid out upon a very pretty, theoretical principle of carrying the lines right through them; but I do not think they are well laid out with regard to economy of space. There was no necessity, considering the space they have at command, to put them closely; and I would go further and say, that the large scale on which these works are planned gives them a great advantage over works on a small scale. The gasholders, for instance, give a much larger cubical content than a small company could have, and the same with the other buildings; and the convenience of having all these railways through the grounds, and being able to drop their coke into trucks, and carry it straight to the wharf, ought to lead to the economy of space rather than otherwise. I believe the Manchester Corporation have just invited competitive designs for large gas-works, and the maximum they have allowed per million feet of manufacture is 2 acres. If this company obtain the other land they ask for in the bill, there is no necessity whatever for them to have the land belonging to the Board. They have proved themselves that the stations other than Beckton produced last winter 40 million cubic feet per day, and that they manufactured 17 millions at Beckton. They have 150 acres of land at Beckton. They have 150 acres at Bromley, of which something like 15 acres only are occupied by the company, which goes in among the 40 millions I have just spoken of. Deducting 5 millions for what Bromley did last winter, they have 35 millions for stations other than Bromley and Beckton. The bill gives them 150 acres, independently of this piece of land of the Metropolitan Board. They have acquired 12 acres of land additional in connexion with their Kensal Green works, giving them a total acreage of 395 acres for their manufacture, independently of the 35 millions per day which the stations other than Beckton are capable of producing, and do produce. If you divide the 395 by their own figures, which I consider to be quite unnecessary, it brings out their figure of manufacture other than on the Metropolitan Board of Works ground at 95 millions, add the 35 millions at the other stations, and you get 130 millions as the total capacity of production by the area, according to their own rule of manufacture, without taking this 24 acres from the Metropolitan Board. I may say, that it is not the custom to manufacture residual products in the Metropolis. The metropolitan gas companies are producing large quantities of ammoniacal liquor and tar, and it has become worth the while of manufacturers to set up a number of manufactories about London, and they compete by tender for the tar and ammoniacal liquor produced; and my opinion is that they cut the profit of that trade so fine, and that as manufacturers they understand it so much better than we do, that between the two there is nothing for us to get out of it. I am making sulphate of ammonia at a small works in the country, and I simply do so because there is no manufactory within a reasonable distance for the transfer of ammoniacal liquors; therefore, the liquors do not pay, and we have to get rid of them in other ways. There is no necessity for the Chartered Company to have this land to manufacture residuals upon. The tar and ammoniacal liquor in gas-works are usually and readily pumped; and, therefore, can be transported anywhere on land adjoining, which might be easily got, for the purpose of manufacture.

Cross-examined by Serjeant SARGOOD: I have no special knowledge of the fact that the land round the works might be easily got. The Commercial Company do not carry on so large a trade as the Chartered, but this is to their disadvantage, because their works, built up from time to time as required, could not be so economically constructed as these might have been. Speaking relatively, I disapprove of the way in which the Beckton works have been laid out. In the works referred to in my table, I think they carry on the business of repairing their own machinery, as the Chartered Company do. In the Commercial Company, we do most of our own fitting work ourselves. We do not make our own castings, or our own retorts, and I question the expediency of doing it. We repair our own machinery. We do not burn our own lime, and I should not think the profit upon doing it would make it worth while. We have no great space for spent lime, and we do not attempt to store it. We should look upon it as an act of folly to buy land to store spent lime upon, because we can sell it. We have been using lime upon the land belonging to our Wapping works. At Beckton the purifying space is necessarily large—about the same in proportion as at Wapping. There are no railways in the works referred to in my tables; if there were, it would be an advantage, as adding to the expedition. We can store all the coke and breeze that we consider it wise and prudent to store. We can store ten days production.

Serjeant SARGOOD: Now, with regard to the acquisition of acreage. You have been kind enough to give various instances, showing a considerable number of acres, but do you not know that, in the acquisition of other companies, while we were obliged to take all the land they had, Parliament, at the same time, gave special power to the Chartered Company to sell surplus land, in order that they might so get rid of the old works?

Witness: Yes; but they have not exercised the power very largely.

Serjeant SARGOOD: Of course not; but they will be compelled to exercise it before long, I expect?

Witness: I think not. I think that, where they have put down the retort part upon the plan, they have put up gasholders to supplement what they have at Beckton. I know that they have increased the gasholders.

Serjeant SARGOOD: In the aggregate of that 395 acres, tell me what stations you include?

Witness: Beckton, 150 acres; Bromley, 150 acres; the portion of land at Beckton, upon which you are not opposed before this committee; and 83 acres and 12 acres at Kensal Green, which you are not opposed upon.

Serjeant SARGOOD: You know probably that, with regard to some of the land which we acquired from other companies, we have sold some?

Witness: I believe you sold the bit at Blackfriars.

Serjeant SARGOOD: Only to the extent of £185,000, or something like that?

Witness: Yes; although it was a very few acres, it was a very valuable site.

Serjeant SARGOOD: Then there was Curtain Road, a little trifle of between £30,000 and £40,000?

Witness: Yes; but I think you kept some land in that neighbourhood for gasholders—either there or in Worship Street.

Serjeant SARGOOD: I dare say you will agree with preceding witnesses, that the great object of going to Beckton was to get the manufacture of gas as far from the Metropolis as possible?

Witness: I do not agree with that.

Serjeant SARGOOD: Although the public have been pressing for it for the last ten years?

Witness: I have heard that stated, but I do not recollect it.

Serjeant SARGOOD: You really do not know that there has been a pressure put upon gas companies to take the manufacture out of the Metropolis rather than keep it in?

Witness: I do not know that. I have never heard of a gas company being so indicted for a nuisance that they have been obliged to take their works out of the Metropolis.

Mr. CRIPPS then addressed the committee, and submitted that the Metropolitan Board, as a public department, having important duties to discharge, were bound to come forward in defence of their possession of the land in question, seeing that it would hereafter become necessary for their sewage outfall—more especially when it was believed that its acquisition by the company was not in any way indispensable for their operations. The company,

indeed, did not require it for any of the purposes for which they were incorporated, but for the purpose of carrying on certain business, which, in their opinion, would be economical to them. The Metropolitan Board opposed this notion, believing that the company should be restricted to the manufacture of gas alone, and not speculators in other things, which might or might not turn out well for the consumers and the public. He thought the Metropolitan Board had completely established their case. The company were in no sense a public body, and they had made out no such strong case as should influence the committee to require the Board to part with the land in question.

Serjeant SARGOOD was heard in reply. He said the case set up by the Board before their lordships was a perfectly distinct one from that which they submitted to the House of Commons. All that they said then was that they might possibly want this land hereafter, when it became necessary to enlarge their reservoir. Whereas now they put it forward as an absolute necessity for that purpose, and as probably required for some imaginary object which Parliament might some day call upon them to carry out. The case for the company was that the acquisition of this land would enable them, as a public body, having important duties to discharge, to perform that duty more cheaply and efficiently. The evidence they had called went to show that, for the purpose of extending their reservoir, or making additional outlets, this land was not essential to the Board, but if in the judgment of the committee a portion of this land should be reserved for the purposes of the Board, the promoters would accept the arrangement suggested when the bill was in the House of Commons, and reserve 100 feet, which was the greatest quantity it had been shown they could require.

The committee-room was then cleared. On the parties being again called in,

The CHAIRMAN said the committee are of opinion that no sufficient reason has been shown for giving any of the land of the Metropolitan Board to the gas company.

The other portions of the bill were then proceeded with, and the clauses having been gone through, clause 5 being amended to carry out the decision of the committee,

The preamble was read and agreed to, and the chairman was directed to report the bill, as amended, to the House.

Miscellaneous News.

METROPOLIS GAS SUPPLY.

The report of Dr. Williamson, chief gas examiner, on the gas supplied by The Gaslight and Coke Company, the Imperial Gas Company, and the South Metropolitan Gas Company, during the months of April, May, and June, 1876, contains the following, amongst other, particulars:—

Maximum, Minimum, and Average Illuminating Power in Standard Sperm Candles.

Kind of Gas and Testing-Place.	Max.	Min.	Aver.
The Gaslight and Coke Company—			
Common gas, Beckton	18·5	15·8	17·3
,, Ladbroke Grove	17·7	16·1	16·7
,, Friendly Place	17·3	16·0	16·8
Cannel gas, Millbank Street	22·7	20·0	21·0
Imperial Gas Company—			
Common gas, Bruce Terrace	17·8	16·0	16·5
,, Carlyle Square	19·9	15·0	16·9
,, Camden Street	17·8	15·2	16·4
,, Graham Road	18·3	16·0	17·3
South Metropolitan Gas Company—			
Common gas, Hill Street	17·0	14·5	15·8

The average illuminating power has been always more than required by the Acts of Parliament. A deficiency in the illuminating power has occurred rarely, and then only to a very slight extent. Sulphuretted hydrogen has never been present in the gas at any of the testing-stations. The proportions of sulphur in other forms than this were as follows:—

Grains of Sulphur per 100 Cubic Feet of Gas.

Kind of Gas and Testing-Place.	Max.	Min.	Aver.
The Gaslight and Coke Company—			
Common gas, Beckton	15·9	4·7	10·6
,, Ladbroke Grove	18·1	10·3	14·3
,, Friendly Place	15·1	5·5	9·9
Cannel gas, Millbank Street	17·6	9·6	14·5
Imperial Gas Company—			
Common gas, Bruce Terrace	15·3	5·0	8·9
,, Carlyle Square	22·1	12·2	15·9
,, Camden Street	16·3	7·8	10·6
,, Graham Road	17·9	12·7	15·4
South Metropolitan Gas Company—			
Common gas, Hill Street	23·0	6·7	12·5

The gas at Beckton, Friendly Place, and Bruce Terrace has been of considerably greater average purity than required by the Acts of Parliament; and at each of these stations it has only once contained a little more sulphur than allowed by the Acts. At Ladbroke Grove, Millbank Street, Camden Street, and Graham Road, the sulphur has never come up to the quantity allowed. At Carlyle Square and Hill Street respectively, the gas has only once contained more sulphur than allowed by the Acts, while the average at both stations has been well within that limit. At Bruce Terrace and Millbank Street the gas has been perfectly free from ammonia throughout the entire quarter. At Ladbroke Grove ammonia has only been present on three occasions, and then in very small quantities. From Carlyle Square the returns, although, on the whole, very favourable, show some remarkable variations. At Graham Road the returns show almost uniform absence of ammonia during the months of April and May, and the almost regular presence of it after the first few days of June. At all the remaining stations the average quantity of ammonia has been very far smaller than that allowed by the Acts of Parliament; but at Hill Street the ammonia was, for several days, in greater quantity than usual, and during two of those days in excess of the quantity allowed by the Acts.

METROPOLITAN BOARD OF WORKS.

At the Meeting of Board on Friday last—Sir JAMES HOGG, M.P., in the chair—the Parliamentary Committee presented the following report:—

Your committee have to report that they have again had under consideration the bill introduced by the Board of Trade for the regulation of the London, Phœnix, and Surrey Consumers Gas Companies. It will be remembered that, after the adoption of the report of your committee last Friday, there remained two points upon which the Board differed from the provisions of the bill, and in respect of which representations were made to the Board of Trade. One was that the power of the companies to acquire land by agreement should be subject to the conditions contained in the 5th section of the Gas-Works Clauses Amendment Act, 1871, which requires a company to obtain the written consent of the owners and occupiers of any dwelling-house within 300 yards of any place where gas is to be stored or manufactured. The other was, that by the bill it was proposed that the power of amalgamation of the three companies on the south side should be extended to the South Metropolitan Gas Company, and your committee had expressed the opinion that the last-mentioned company should not be included in any amalgamation under the bill.

These views have been communicated to the Board of Trade, and a letter has since been received from that department, stating that the companies have agreed to omit altogether the clause relating to the acquisition of land. With reference to the question of amalgamation, however, the Board of Trade is of opinion that the amalgamation of the gas companies on the south side of the Thames should be general, and that the South Metropolitan Company should not be excluded, the Board of Trade contemplating as desirable, the complete amalgamation of the four companies on the south side, as distinct from the companies on the north side.

Upon a reconsideration of all the circumstances connected with this question, it appears to your committee desirable that the Board should adopt, upon this point, the suggestion of the Board of Trade, and that the clauses in the bill relating to amalgamation should be extended to the South Metropolitan as well as to the other three companies dealt with by the bill, and they recommend accordingly.

Mr. FREEMAN (Chairman of the Parliamentary Committee): I think there is a letter of considerable importance from the Board of Trade which had better be read now.

The CLERK read the following letter:—

Board of Trade, Whitehall, July 10, 1876.

Sir,—With reference to the conversation between yourself, Mr. Ward, and Mr. Shrubsole, on the part of the Metropolitan Board of Works; Mr. Baxter on the part of the London, the Phœnix, and the Surrey Consumers Gas Companies; the Chairman and Mr. Livesey on the part of the South Metropolitan Gas Company; and the President of the Board of Trade, on the subject of the Metropolis Gas (Surrey Side) Bill, I am directed to submit the following observations for the consideration of the Metropolitan Board of Works:—

There were three points mentioned in your letter of the 7th inst., and referred to in the above conversation. 1. The acquisition of land. This was settled by the companies agreeing to your proposal to strike out the clauses. 2. The reserve-funds. This was settled by the agreement of the Metropolitan Board to the clauses in the bill. 3. The proposal in clause 61, that the power of amalgamation should extend to other companies south of the Thames. Practically, these words apply to the South Metropolitan Company only, and there is no objection to limiting them expressly to that company.

It is very desirable that the exact consequence of omitting these words should be brought distinctly to the notice of the Metropolitan Board of Works. It is admitted on all hands that amalgamation is desirable in the interest of the consumer, and the principle of amalgamation has been approved by Parliament. The great question now is whether there shall be one amalgamated company for all London, or two companies, one on the north and the other on the south side of the Thames. The Metropolitan Board, so far as the Board of Trade are aware, are in favour of two companies. If this bill passes with the words in question, this object can, and will, in all probability, be attained; and the consumers of gas on the south side of the Thames will all share in the advantages of the present excellent position of the South Metropolitan Company, even though the initial price in the district of that company should be 3s. 9d. as in the rest of London, and not 3s. 6d. as fixed by the present South Metropolitan Bill.

But if these words are not inserted, the position will be very different. There is, in the first instance, no security that the South Metropolitan Bill will pass, since that company can drop it at any moment. But whether it passes or not, it will be in the power, as it is believed to be the desire of the Chartered Company to amalgamate with the South Metropolitan Company, and thereby make the initial price in that district 3s. 9d., whilst the omission of the words in question will prevent the possibility of an amalgamation of the southern companies.

Should no such amalgamation be possible or probable, it will be very difficult for the Board of Trade to withhold their consent to an amalgamation of the southern companies with the northern companies, and such a result would not only defeat the object which the Metropolitan Board have in view, but would make the initial price in the district of the South Metropolitan Company 3s. 9d., and not 3s. 6d.

Under these circumstances, the Board of Trade trust that the Metropolitan Board will very seriously reconsider their suggestion to strike out the words in question.

I have the honour to be, sir, yours obedient servant,

T. H. FARRER.

Sir James Hogg, K.C.B., M.P., Metropolitan Board.

Mr. FREEMAN, in moving the adoption of the report, said the Board were aware that the committee had been engaged during the whole session in endeavouring to obtain such terms, with respect to the supply of gas, as they believed were fair both to the consumers and to the companies. They had been successful, as far as the north side of the Metropolis was concerned; and the question was settled there as to initial price, illuminating power and purity, sliding scale, and auction clauses, all of which would tend to secure economy of management, and guard the public against any abuses. But it was extremely desirable to settle the question for the whole of the Metropolis, and for that purpose to get similar provisions enacted for the companies on the south side of the Thames. The bill which the Board promoted would, of course, have extended to the whole Metropolis; but, unfortunately, it was opposed by all the companies, and the Government were not active in lending assistance in forwarding the measure. The Board, therefore, availed themselves of a bill promoted by the Chartered Company to secure these desirable advantages over the north side; and the Board of Trade had now a short bill in Parliament, which, if carried, would confer the same advantages on the south. The only difference between this bill and the bill of the Metropolitan Board was, that the former would permit of the amalgamation of the southern companies, with the consent of the Board of Trade. The companies had agreed to give up those clauses which would enable them to take land by agreement for the storeage or manufacture of gas, without obtaining the assent of the owners and occupiers of adjoining land within 300 yards; and, so far as that point was concerned, they would, if the bill passed, be subject to the general regulations affecting gas companies. The only remaining point upon which this Board raised any objection related to the power, proposed to be given to the three companies, to amalgamate, being extended to the fourth company—the South Metropolitan. Upon that point the Board of Trade were against them. Now, it must be borne in mind that the Board of Trade were an institution; they existed, and it was no use trying to ignore the fact. It had a certain policy, also, on the gas question, and this could not be ignored. That policy was to promote amalgamations on the south side of the river, as well as on the north. The Metropolitan Board were anxious that the South Metropolitan Company should not be subject to those amalgamation clauses, and, on behalf of Camberwell and Lambeth, they had done everything in their power to retain to those parishes the monopoly, as he might call it, of a cheap supply of gas—at least, to continue to them the exceptional state of things they enjoyed. Resolutions on the subject were accordingly passed by this Board, and were communicated to the Board of Trade; but the latter did not assent to them. Then came a communication from the Board of Trade, asking the chairman (Sir J. Hogg) and the solicitor to go and have an interview with the President, which they did, some other parties being present. The chairman asked him (Mr. Freeman) to accompany them, and he assented, thinking that he might be of some service in the matter. They went to the Board of Trade to talk the matter over, and it was very frankly talked over, but he could assure the members for Lambeth and Camberwell that the deputation from this Board continued during the whole interview to support the resolution which the Board had adopted on the question, and not the slightest intimation was given of any intention to give way on the point. They defended the position the Board had taken up against the amalgamation of the South Metropolitan Company, and he was not sure that they were not a little rude when they told Sir C. Adderley that if this was his policy, and he was determined to pursue it, it was but little use continuing to talk over the matter. They heard all that the President had to say, and now they had to report that it was clearly the determination of the Government that this amalgamation should be effected. Under these circumstances he would ask the members for Lambeth and Camberwell, who were more especially interested in the question, to consider what might be the consequence of this Board refusing to coincide. It was true the South Metropolitan Company now charged 3s.; it was possible also, that, after an amalgamation, the price of gas in that district might be raised to 3s. 6d.; but they were told that the great chance was that the result of the amalgamation would be to promote such economy of management that the price would go down and not up, so that not only would the parishes supplied by the South Metropolitan Company not suffer themselves, but, by agreeing in the amalgamation, they would be the means of doing good to those districts supplied by the other southern companies. Such being the case, they would be acting in a selfish spirit not

to endeavour to help their neighbours, and would be throwing away the chance of obtaining a settlement of this long vexed question. He thought, therefore, it would be better to give way, believing, as he did, that in the end all things would work together for the good of the inhabitants on the south side, who would still get their gas as cheap as it could be had—cheaper, indeed, than it was supplied to the majority of the consumers of London. The committee had advocated the cause of Lambeth and Camberwell, but had failed to support all their claims, and he now asked the representatives of those parishes to take a metropolitan view of the affair, and to believe with him that, as he said before, all things would yet work together for the good of the inhabitants of the Surrey side of London.

Mr. DRESSER ROGERS moved, as an amendment—"That this Board are of opinion that no amalgamation should take place with the South Metropolitan Gas Company, unless under parliamentary sanction." Of course the Board were not unaware of the fact that for many years past the parishes of Camberwell, Lambeth, and Wandsworth had together fought, in the House of Commons, battle after battle to maintain their position. No doubt they had been fortunate, to some extent, in having a gas company in their midst which could make gas and supply it at 3s. per 1000, while paying their own shareholders 10 per cent., and putting by a considerable reserve-fund. But he had yet to learn why this Board, which represented the Metropolis, should go out of their way to assist in robbing the consumers of South London of their privileges. (Order, order.) He would withdraw the word "robbing" if his friend did not like it, but he confessed that he felt rather warmly upon this subject. He would ask why should the Board go out of their way to deprive the South London parishes of their privileges? The Board, at the commencement of the present session, introduced a bill into Parliament for adjusting the gas supply of the whole Metropolis; but by some jugglery—(order, order)—well, by some process which passed his comprehension, that bill had been lost.

Mr. FREEMAN: It is still before the House of Commons.

Mr. ROGERS maintained that it had been lost, and could not even be found in the cellars of the House of Commons. That bill had gone, and in its place what did they find? They found the Board of Trade coming forward with a bill affecting the South London companies only, identical in every respect with their own, except that it contained amalgamation clauses. To all intents and purposes the Board of Trade had defeated this Board's bill on that point. (Mr. FREEMAN: Hear, hear.) Why did not the bill promoted by this Board contain amalgamation clauses? Because the Board, on more than one occasion, had declared their opinion that it was not expedient, and that they would oppose the attempt to introduce any provision giving power to the South Metropolitan Company to amalgamate. So recently as the 5th of May last they passed a resolution—"That the Board do oppose the clause in the South Metropolitan Gas Company's Bill which would authorize the company to amalgamate with others in the Metropolis." Four or five years ago the Phœnix Company brought a bill into Parliament to enable them to amalgamate with the other companies, but the parishes of Camberwell and Lambeth opposed it; this Board also fought against it, and the bill was thrown out of the House of Commons. At a subsequent period the South Metropolitan Company themselves sought to obtain similar powers; that bill also was opposed, and defeated upon every occasion. It had been shown by the evidence of experts that there was no reason why that company should not be able to continue supplying gas at 3s., and comply with all their statutory obligations. At one time this session, when this Board proposed to go for a bill which should settle the gas question for all London, the parishes of Lambeth and Camberwell, though deeply interested in the maintenance of the existing state of things in their respective districts, were content to stay their hands, and not interpose objections, believing the measure would be for the good of the public generally; but that reason no longer existed. What was now the case? The Board's bill had been burked, and a bill had been brought in to effect that which the Board had protested against, and to prevent the inhabitants of South London any longer obtaining gas at 3s. per 1000. The parish of Camberwell, for area, was the largest parish represented at the Board; they had hitherto enjoyed the benefit of being supplied with gas at 3s., and why should they now be deprived of that privilege by the action of the Board? The chairman of the Parliamentary Committee expressed an opinion that, if the Board of Trade bill passed, the price of gas all over South London would be reduced. At the present time, the Phœnix Company (a very well-managed company, but having an excessive capital) were charging 3s. 6d; the London Company, 3s. 6d.; the South Metropolitan Company, 3s.; but if this bill passed, the whole South London district would have to pay 3s. 9d. All that he, on behalf of his parish, asked, was that the Board would leave them alone to fight their own battle in the House of Commons. They had done it in the past successfully, and he believed they could do it again. He regretted that they should now have to do it in opposition to the Board, but they were too largely interested in the question to allow the matter to pass without a struggle. The Board, as the representative of the consumers of gas all over London, ought to come forward for their protection. But here would be a strange spectacle—the Metropolitan Board acting in opposition to those who were most interested in the case; those who were most seriously affected by the proposed measure being in a minority. Surely it was a strong argument against the adoption of the report, that all those most interested objected to the course it recommended. Why could not the Board leave them alone; they did not want their interference. The Board of Trade, in pressing the question of amalgamation, were legislating for an idea, and not in the interest of the consumers. They seemed to think, moreover, that because in certain parts of the Metropolis the initial price of gas was fixed at 3s. 9d., therefore it should be in all parts, notwithstanding the evidence of experts, and in opposition to the decision of the House of Commons a second time repeated; indeed, the proposition seemed to him so monstrous that he could not think the House of Commons would allow the Bill to pass. The chairman of the Parliamentary Committee had referred to the recent interview with the Board of Trade, and he (Mr. Rogers) did not wish to say anything unkind about that meeting, but he might be allowed to remark that he thought the chairman of this Board might have asked the members most interested in the question to have accompanied him. But what did he find? The South London gas consumers represented on that occasion by the chairman, who was a member for St. George's, Hanover Square, and Mr. Freeman, the member for Kensington!

The CHAIRMAN interposed, and protested against any reflection upon him for the manner in which he discharged his duties. Since he had been chairman of the Board—now six years—it had been his duty to have frequent interviews with departments of the Government—privately and confidentially, officially and semi-officially—and on no one occasion had he ever expressed an opinion which he did not believe would be approved by the Board. He had never, in any way, pledged the Board by what he had said. On the late occasion he was asked to wait upon the President of the Board of Trade with the solicitor, and he asked Mr. Freeman, the Chairman of the Parliamentary Committee, to accompany him, there being no other member that he could ask. He stated to the President that he appeared, without prejudice, to listen to anything that might be said, and that he could not bind the Board in any way or form. After the discussion, he said the best thing the Board of Trade could do would be to put their views in writing, so that he might bring them before the Parliamentary Committee, and afterwards before the Board. That had been done in the letter just read, and he now begged leave to say, that so long as he occupied his present position, he should not shrink from adopting a similar course to that which he had done. He only desired that the Board should have the fullest information, and he would take care they should never be pledged by any statement on his part. The Board were masters of their own actions, and it was the vote of the majority that must determine the policy they would pursue.

Mr. ROGERS said he did not object to the chairman going to the Board of Trade, but he thought that when an interview was about to take place between not only the Chairman and the President, but also Mr. Robert Baxter, Mr. Wyatt, and a number of gentlemen representing the South London gas companies, there ought to have been an opportunity afforded for those who represented the parishes interested to attend. He believed that the chairman, on all occasions, desired to do that which he considered best; but he still felt that the interests of his constituents in this question were so great that some members, to represent the case from their point of view, ought to have been present at the late interview. None but those who were immediately interested could feel so keenly alive to the great injustice proposed to be perpetrated, and the shameful way in which the benefits they now enjoyed were about to be taken away from them. Again, he said, all they desired was to be left alone. If the Board of Trade, in their position, offered to dogmatize in legislation, let them do it; but do not let this Board be a party to their proceedings. He did not believe in any of the advantages which it was said would result from the passing of the Board of Trade Bill; in fact, the South Metropolitan Company's Bill contained exactly similar provisions, and gave them an initial price of 3s. 6d. instead of 3s. 9d.; and if this Board did not choose to help the South London parishes in supporting that bill, at least let them leave the consumers to fight their own battle, and he believed the House of Commons would yet do them justice.

Mr. FOWLER seconded the amendment, because the question at stake was a very important one. The vestry which he represented had, after a long discussion, determined to oppose the bill of the Board of Trade, and to employ experts to give evidence before the committee of the House of Commons, to show that there were reasons why a different initial price should be given in the south to that in the north of London. The chairman of the Parliamentary Committee, in moving the adoption of the report, laid great stress on the fact that the object of the bill was to secure that which this Board in their bill had sought to attain—viz., uniformity of price, uniformity of illuminating power, &c., and that the terms of raising new capital should be the same for all the companies. That would be all very well if they could secure another thing—viz., uniformity of circumstances under which the companies worked; but, when this question came before the committee of the House of Commons, it would be clearly shown that the conditions of the companies were so diverse that it required a higher price to pay full dividends on the north than on the south side of London. The capitals of the companies were not uniform, and did not bear the same proportions to the amounts they paid to their shareholders. Under all the circumstances, therefore, he thought no amalgamations should be allowed without parliamentary sanction, which meant that an opportunity should be afforded to those who were most interested in the question to appear before the House of Commons, and bring out all the facts of the case. He was not satisfied at all with the way in which the Board of Trade had proceeded in this matter. He would not go so far as to say, with Mr. Rogers, that undue influence had been employed, but he would say that he considered the Board had gone much out of their way to introduce such a bill as they had proposed. Nor did he agree with Mr. Rogers in his remark about the conduct of the Chairman of this Board in accepting the interview with the President of the Board of Trade, unaccompanied by the representatives of South London. Perhaps it was impossible to call them together at such short notice, but he did distinctly object to his meeting with a number of people there antagonistic to the views of some members of the Board, without an opportunity being given to them to attend and state their objections. There was no reason why the chairman and vice-chairman should not have confidential communications with any department of the Government, but he objected to the presence of third parties, such as the directors and officers of gas companies, without those whose interests were to be affected being also present. He would call attention to the concluding portion of the Board of Trade letter. It certainly called for strong remarks. It was, to the effect that, if this Board did not agree to their proposal, the consumers of South London would then be thrown into the hands of the Chartered Company. In effect it was a threat that if they did not agree to the bill of the Board something worse would happen to them. No doubt under the provisions of the Chartered Gas Act the Board of Trade could sanction an amalgamation with that company, but he ventured to say that it never was intended by the Legislature that undertakings existing under such different circumstances as the companies on the north and south sides of the Thames should be united in that way. He could very well imagine that benefit might arise from the amalgamation of companies on the same side of the water, because it might be urged that economy of expenditure would be the result, but with the Thames dividing the South London companies from the Chartered district, there was no reason which could be advanced in the interest of the consumers for taking that step, and the Board of Trade ought to refuse any application for such an amalgamation. He hoped, therefore, that this Board would adhere to the resolution they passed on the 5th of May, and say they would oppose any amalgamation of the South Metropolitan Company, except it took place under direct parliamentary sanction. They had already acted upon that resolution before the committee of the House of Commons in reference to the bill of the company, and he could scarcely suppose they would stultify themselves by now agreeing to the insertion of a clause in the Surrey Side Bill, by which they would undo all they had hitherto accomplished.

Mr. RUNTZ said he hoped the Board would save the consumers on the south side of the river from being placed in such an unfortunate position, as they certainly would be if the advice of their representatives was listened to. These gentlemen (Messrs. Rogers and Fowler) came forward in the character of "injured innocents"—(laughter)—as if some great wrong was about to be done to them by this Board. Surely, they must have forgotten the way in which the question was settled last year, and to which settlement they themselves were parties. At that time, certainly, they failed to see any harm in an initial price of 3s. 9d. for 16-candle gas. Every one then agreed that what was done was the right thing to do. The position which the Board took was that, whatever arrangement was come to, it should be done for the interests of the Metropolis as a whole, and that, whatever circumstances might exist favouring the consumers in one district, should not influence the question of general policy as to what was good for London in its entirety. Mr. Rogers talked about experts being called before the House of Commons. They had been called, and it was on the evidence already given by experts before the now celebrated committee of last year, of which Mr. Forster was chairman, that the price of 3s. 9d. was fixed for the whole Metropolis, including the district of the South Metropolitan Company. The only new circumstance that had since arisen was that the question had been settled for the whole north side of the Metropolis, but it had been settled on that basis. How could Mr. Rogers expect that, 3s. 9d. having been declared the proper price on that side, 3s. 6d. would be adopted on the other? Mr. Rogers was inconsistent. He said, in effect, that what was good for the Metropolis as a whole was not good for the Metropolis in two pieces. Surely, this was unjust and unreasonable. This Board had endeavoured to legislate for the whole Metropolis, but in consequence of the amalgamations on the north side the question had been settled there; there the companies had accepted 3s. 9d. as the initial price, the sliding scale, the auction clauses, a 16-candle standard of illuminating power, and, in fact, all that the Board had asked for. On the south side, at the present moment, the law allowed the companies to supply 12-candle gas, and gave them liberty to charge 4s. 6d., if they so pleased. The Board of Trade wanted to settle the question on the south side this session; this Board had also desired it, and they were promoting a bill on the same basis as that adopted in the north, which, if carried, would settle

the question for the whole Metropolis, with this great advantage, that they would have what their late lamented colleague, Mr. Newton, happily phrased "the competition of comparison." They would have two great companies, one on the south and one on the north, whose workings could be from time to time compared and judged, whereas if the bill, now in the House of Commons, slipped through, and was lost, there would be one great company for the whole of London before long. That was what would happen; there could be no doubt about it; the Board of Trade said so in effect, and it would certainly be the case. Mr. Rogers said this Board ought to express an opinion that the South Metropolitan Company should not be amalgamated without going to Parliament. They could do it without, for by the Act of 1871 the Chartered Company could amalgamate them or any other company. They had already made proposals to the southern companies, and whether or not those proposals were carried into effect depended upon Mr. Rogers. If he succeeded in persuading the Board to adopt his amendment, the only effect would be that an amalgamation of the northern and southern companies would be effected; if he did not, and the bill of the Board of Trade became law, the companies on the south side would ultimately amalgamate amongst themselves, and the consumers would have all the advantages already secured for the consumers on the north. Meanwhile they would be able to raise their price to 4s. 6d. for the purpose of making up their reserves, so as to have a nice amount to hand over or divide among their shareholders when the time to amalgamate arrived.

Mr. ROGERS: I object to the statement altogether that the companies have power to raise their price to 4s. 6d.

Mr. RUNTZ: The South Metropolitan Company have the power to amalgamate with the companies on the north.

Mr. ROGERS: They have not.

Mr. RUNTZ: In point of fact, they have; for, by the Act of 1871, the Chartered Company can amalgamate with any company in the Metropolis, which comes to the same thing.

Mr. ROGERS: They must have the consent of the Board of Trade.

Mr. RUNTZ remarked that the Board of Trade would give that consent. What, therefore, was wanted was, that the South Metropolitan Company should have power to amalgamate themselves with other companies on the south, and this Board, if they gave their sanction to such an arrangement, would preserve their consistency, and secure that which would be an immense advantage—the "competition of comparison." The proposal of the Board of Trade promised to settle a question which had been a most expensive one to this Board, upon which they had spent many thousands of pounds, and would have to spend many thousands more. Once settled, the question would not be likely to rise again—certainly, not for many years—because the consumers interests would be identical with those of the shareholders, and the more economy the companies practised, the larger would be the dividends they would be allowed to pay.

Mr. RICHARDSON said the position of things on the south side of the Metropolis was very unfortunate, mainly owing to the action of this Board. What had happened this session? The South Metropolitan Company brought in a bill, asking that they might be allowed to increase their capital and make certain arrangements, and they inserted an initial price for gas of 3s. 9d. This Board, although representing the consumers, did not appear apparently to oppose.

Mr. ROGERS: They opposed the amalgamation clauses, and succeeded.

Mr. RICHARDSON said they left it to one of the constituent parts of the Metropolis to oppose the 3s. 9d. price. That local body succeeded in getting the price reduced to 3s. 6d., and the bill had since passed the House of Lords with that price fixed in it. Now came the Board of Trade at the last moment, and asked this Board, through their Parliamentary Committee, to accept a measure, which, if carried, would give the company 3s. 9d., notwithstanding the decision already expressed on the subject by both Houses of Parliament. And yet they were told that this was in the interests of the consumers.

Mr. LLOYD: Of the whole of South London.

Mr. RICHARDSON said one part of South London was to be sacrified for the benefit of the whole. What was the origin of this state of things? He must go back to the passing of the Act of the Chartered Company in 1871. Unfortunately, this Board acted under a mistake at that time, for they were parties to accepting clauses in the bill enabling the company to amalgamate with any other companies, whether in the north or the south. Those very clauses were now being used as a screw upon the Board, who were threatened that if they did not accept the new bill of the Board of Trade the companies would amalgamate under the existing legislation. Even if the South Metropolitan Company got their bill, it would not matter an atom; The Gaslight and Coke Company could amalgamate them at once, and charge 3s. 9d. throughout their district. It was a most unfortunate thing; never was a greater mistake committed. It only showed how a public board, with the best intentions, might be misled into a course of action, apparently in the interests of the consumers, but in reality quite contrary thereto. What did the Board of Trade say in their communication? "It is admitted on all hands that amalgamation is in the interests of the consumers, and has been approved by Parliament." Now, there might be certain circumstances in which amalgamation might be desirable, but it was not so in this case; indeed, it would be far better left alone. Then the Board of Trade stated that they were most urgently impressed with the importance of having two companies—one on the north and another on the south. But supposing the views of the Board of Trade were carried out, and two companies were formed, it would be in the power of The Gaslight and Coke Company immediately to bring about an amalgamation of the two under the powers of their own Act, unless this Board went to Parliament and got the amalgamation clauses of that Act entirely repealed. The solicitor told him that it was impossible to do that this session, no notices having been given for the purpose, but they might go next session; and he thought it would be well they should do so. He looked upon the present state of things as most unsatisfactory. If there was to be an amalgamation on the south side of London, it was clearly to the interests of his constituents that the South Metropolitan Company should be brought into it; but he wanted to be consistent with himself, and he must press upon the Board not to adopt a course of action directly opposed to their proceedings in the early part of the session. So contrary, indeed, was the recommendation of the committee, that it was a question with him whether the Board would not require a special meeting before they could adopt it.

Mr. LLOYD said he had been trying to discover any real reason for the adoption of the amendment, which, if carried, would put a stop to all legislation for this session. His friend, Mr. Richardson, said the Board were in a worse position now than ever. How could that be? If the proposition had come before them last year, to secure gas for the whole of London at 3s. 9d., with an ascending and descending scale, the Board would have unanimously adopted it. Why not now? He quite agreed with Mr. Runtz that there should be but one initial price for the whole of London. The Board were prepared to accept that last year. Why should they not now do it? A great deal had been said about the districts in which the mover and seconder of the amendment lived. But then it should be recollected that the south of London was interested in four companies, and if nothing were done this session but the equalization of the rates of charge it would be desirable. At present, if a rise in the cost of coal took place, three of those companies could raise the price of gas to 4s. 6d.

Mr. JONES: 5s. 6d.

Mr. LLOYD thought it was most desirable to get the question settled this session, and place all the companies in such a position that they could never charge more than 3s. 9d. while paying 10 per cent. dividends. It would make very little difference to the consumers whether the initial price was 3s. 9d. or 3s. 6d., and, after all, it by no means followed that if 3s. 9d. or 3s. 6d. was fixed as the initial price, the companies would charge the full amount. They would have the power to do it, undoubtedly; but the effect of the proposed legislation would be to make the companies desirous of charging the very lowest price they could, so that they might be able to increase their rates of dividend. With reference to the power of the Chartered Company, with certain consents, to amalgamate with any other company, he should very much like to see that power repealed, but he doubted whether it could be done. At all events, as that power existed, it would surely be well that the southern companies should have power to amalgamate amongst themselves.

Mr. JONES said, upon reading the amendment placed upon the table by Mr. Rogers, and seconded by Mr. Fowler, he found that it went to the effect that no further amalgamations should take place except under legislative sanction. But he (Mr. Jones) held in his hand a copy of the bill of the Board of Trade, by which it was proposed to amalgamate the southern companies. That bill had been read a second time, and referred to a select committee, so that if the suggested amalgamations took place, they would be effected under parliamentary sanction. In the meantime, when the bill came on for hearing before the select committee, his friends would have the opportunity of being heard against it.

Mr. FREEMAN, in reply, complained of the remarks made by Mr. Rogers, who said the Board had gone out of their way to wrong his constituents. They certainly had gone very much out of their way in the other direction. They passed a resolution in the early part of the session, to which their minds and consciences scarcely assented, to endeavour to prevent the amalgamation of the South Metropolitan Company, but they now found that that resolution could not be maintained any longer. It appeared to him that it was rather a misfortune the Board ever listened to the eloquence of Messrs. Rogers and Fowler, and allowed themselves to be carried away by the force of character and tremendous determination of the members for Lambeth and Camberwell. Mr. Fowler complained that the Board of Trade had attempted to frighten them by threats of an unseemly and improper character. But suppose the Board of Trade had not added the remarks referred to, and this Board had refused to stand aside and let the Surrey Side Bill pass, and the Board of Trade had then said, "Since you are taking the part of the dog in the manger in not allowing the amalgamation it proposed to take place on the south side, we cannot withhold our sanction to such an arrangement under the Chartered Company's Act,"—what would Mr. Fowler have said then? He would certainly say that it was wrong not to have warned them, so as to enable them to take the wiser course and choose the lesser evil. Mr. Rogers remarked it was pitiful to see the members for the south side in a minority, and, although the most interested in the question, having no sympathy from the other members. In empanelling a jury, it was not the custom to summon interested parties, and he should have supposed the disinterested members of this Board were more likely to take a metropolitan view of the question now before them, unaffected by Camberwell on the brain or the depressing influence of Lambeth. It was the majority of the Board by whom such points must be settled, and not by those only whose districts were chiefly affected. Then Mr. Richardson complained that the course taken by the Board had been most unwise and improper. Of course, Mr. Richardson did not consider himself a member, and could not be responsible for what had taken place. Surely if any one member might be expected to find out errors and blunders in any course recommended, it was their friend, Mr. Richardson. He must have neglected his post altogether at the time these unwise and improper proceedings occurred, and now he came forward in a most virtuous manner to wash his hands of them altogether. But passing by all these remarks, he (Mr. Freeman) would call the attention of the Board to the real point they had to decide. It was this—would they assent, or rather would they no longer oppose this proposition of the Board of Trade? He thought that if they adopted the recommendation of the Parliamentary Committee, the question of gas legislation would be settled, and the Board would no longer have to spend their time in its consideration. Justice would be done to the companies on the one hand, and to the consumers on the other; and if there should be one district on the south side which lost a little, the other portions would gain considerably. This was the metropolitan view he took of the question, and he ventured to think it would prove more acceptable to the Board than the narrow view advocated in the amendment.

The amendment was then put and negatived, the numbers being—

For	4
Against	19
Majority against	15

On the original motion—"That the report of the committee be adopted"—there appeared—

For	20
Against	2
Majority	18

The report was therefore adopted.

Dr. Whitmore's report on the illuminating power, pressure, and quality of the coal gas consumed in the parish of Marylebone, and supplied by The Gaslight and Coke Company, during the month of June, 1876:—

	Illuminating Power in Sperm Candles.			Mean Pressure in Tenths of an Inch.		Mean Quanty. of Sulphur in 100 Cu. Ft.	Mean Quanty. of Ammon. in 100 Cu. Ft.	Sulphuretted Hydrogen.
	*Mean of 23 Obser.	Highest.	Lowest.	Highest.	Lowest.	Grains.	Grains.	
Gas supplied from the Fulham works	16·51	17·60	15·80	22·31	8·72	12·64	0·50	No trace
Gas supplied from the Beckton and Bow works	16·47	17·31	16·00	31·10	14·20	12·77	0·50	No trace
Cannel gas supplied from the Pimlico works	20·84	22·91	20·24	18·58	11·62	15·91	0·56	No trace

Mean of daily readings of barometer . . . 29·76
" " " thermometer . . . 66·95

* Each observation consists of ten readings of the photometer, at intervals of one minut

During the month the mean illuminating power of the gas supplied to the parish by The Gaslight and Coke Company, from their Fulham works, was equal to the light from 16½ sperm candles; it ranged between 15·80 and 17·60 candles; once only was it under the standard. The mean amount of sulphur found in 100 cubic feet of this gas was 12·64 grains, and of ammonia half a grain. The gas supplied from the Beckton and Bow works gave a mean light equal also to about 16½ candles; it ranged between 16 and 17·31 candles. The mean quantity of sulphur found was 12·77 grains, and of ammonia half a grain. The cannel gas supplied from the Pimlico works gave a mean light equal to nearly 21 candles; it ranged between 20·24 and 22·91 candles; twice it exceeded 22 candles. The mean amount of sulphur found in this gas was 15·91 grains, and of ammonia a little over half a grain. The pressure of all the three gases was satisfactory, and on no occasion was sulphuretted hydrogen detected by the ordinary tests.

METROPOLIS WATER SUPPLY.

The Registrar-General publishes the following returns of the average daily quantity of water supplied by the London Water Companies during the month of June, 1876. According to these, 123,192,817 gallons, or 559,721 cubic mètres of water (equal to about as many *tuns* by measure, *tons* by weight) were supplied daily; or 2¾ gallons (106·3 decalitres) rather more than a *ton* by weight, to each house, and 33·0 gallons (15·0 decalitres) to each person, against 34·6 gallons during June, 1875. According to returns of the London Water Companies made to the select committee on East London Water Bill (session 1867), it is estimated that, during the year 1866, about 82 per cent. of the total supply of water for all purposes was for domestic use; applying this proportion to the total quantity supplied daily in the month of June, 1876, it may be estimated that about 101,018,110 gallons were used for domestic purposes, or about 27·0 gallons per day for each inhabitant, against 28·4 in the corresponding month of last year. This proportion varies from month to month, but the Registrar-General has no means of giving a more reliable estimate.

Companies.	Number of Houses, &c., supplied in June, 1875.	Number of Houses, &c., supplied in June, 1876.	Aver. Daily Supply of Water in Gallons* during June, 1875.	Aver. Daily Supply of Water in Gallons* during June, 1876.
Total supply	518,127	526,541	127,381,916	123,192,817
From Thames	243,652	248,181	65,403,955	63,824,721
„ Lea and other Sources	274,475	278,360	61,977,961	59,368,096
THAMES.				
Chelsea	28,555	28,675	8,356,200	8,109,100
West Middlesex	46,899	48,116	10,732,438	10,834,702
Southwark and Vauxhall	80,102	80,498	19,263,000	19,560,200
Grand Junction	35,709	36,616	12,524,217	12,166,819
Lambeth	52,387	54,276	14,528,100	13,153,600
LEA AND OTHER SOURCES.				
New River	123,280	124,323	29,378,000	26,653,000
East London	107,294	109,375	24,964,675	24,984,000
Kent	43,901	44,662	7,635,286	7,731,096

* Including that for manufactures and for various purposes other than for domestic consumption.

Note.—The return for June, 1876, as compared with that for the corresponding month of 1875, shows an increase of 8414 houses, and a decrease of 4,189,099 gallons of water supplied daily.

Dr. Frankland, F.R.S., reports, as the result of his analysis of the waters supplied to the Metropolis during June, that, taking unity to represent the amount of organic impurity in a given volume of the Kent Company's water, the proportional amount in an equal volume of water supplied by each of the other metropolitan companies was—New River 1·9, West Middlesex 3·3, East London 3·4, Southwark 5·2, Grand Junction 5·6, Chelsea 5·7, and Lambeth 6·6. The waters supplied to the Metropolis from the Thames and Lea in June had assumed their usual summer quality, and contained but about one-quarter of the proportion of organic impurity they contained during the period of the worst winter floods. All the waters had been efficiently filtered before delivery, except that supplied by the Southwark Company, which was slightly turbid, and contained numerous moving organisms. The Kent Company's water was "clear, brilliant, and wholesome."

Dr. Whitmore's report on the composition of Thames companies and other waters supplied to Marylebone during June, 1876:—

	Total Solid Matter in degrees or grains per Imperial gallon.		* Loss by incineration of Solid Matter in previous column.		Hardness before boiling, in degrees.	Hardness after boiling 15 minutes, in degrees.
	June, 1875.	June, 1876.	June, 1875.	June, 1876.		
Distilled Water	0°	0°	0°	0°	0°	0°
West Middlesex	18·36	18·40	0·80	0·72	12·50	2·80
Grand Junction	17·92	19·04	0·88	0·88	12·80	2·90

* The loss by incineration represents the amount of organic and other volatile matters contained in the Imperial gallon (70,000 grains) of water.

	Chlorine, in Grains, per Gallon.	Parts per Million. Free Ammonia.	Albuminoid Ammonia.
West Middlesex	1·66	0·00	0·07
Grand Junction	1·08	0·01	0·08

The water of both companies, as seen through a glass tube, 2 feet in length, was clear, bright, and colourless.

EUROPEAN GAS COMPANY, LIMITED.

An Extraordinary General Meeting of Shareholders was held at the Office of the Company, 11, Austin Friars, London, on Wednesday, the 12th inst.—WM. WHITE, Esq, in the chair—for the purpose of confirming the resolution adopted at the Extraordinary General Meeting on the 21st ult., with reference to the Rules and Regulations of the Company.

The GENERAL MANAGER (Mr. H. M'L. Backler) read the notice convening the meeting, and

The CHAIRMAN moved the following resolution:—"That the resolution passed at the Extraordinary General Meeting of the company, held on June 21, 1876, whereby it was resolved—'That the existing rules and regulations of the company, including he alterations and additions made thereto, by special resolutions passed at various times, be, on and from the day when this resolution shall be duly confirmed, in the manner prescribed by the Companies Act, 1862, repealed, and that the rules and regulations contained in the document now produced to the meeting, and signed by William White, Esq., the chairman of the meeting, shall thenceforth be the rules and regulations of the company, to the exclusion of, and in substitution for, the existing rules and regulations. But that the repeal of the existing rules and regulations shall not affect anything done, or any right acquired, or liability incurred, thereunder, by the company, or any member thereof, or other person, previously to such repeal'—be, and the same resolution is hereby confirmed."

The resolution was put to the meeting, and carried unanimously.

This concluded the business of the extraordinary meeting.

The Annual General Meeting of the Shareholders was then held.

The GENERAL MANAGER having read the notice convening the meeting, read the following report:—

Gentlemen,—At Amiens the increase of profits was unusually large in the previous year, partly owing to sales of surplus coals; but similar opportunities not having occurred during the period now under consideration, a large portion of the difference may be thus accounted for.

Your directors prepared you for a less favourable result here when they stated, in the half-yearly report presented to the meeting held in January, that the closing and transfer to other districts of several factories was prejudicially affecting the company's business. They regret now to state that no improvement has yet taken place, but the earnest endeavours of the manager are directed to encourage the general use of gas, by offering facilities for the acquisition of fittings, and otherwise.

The important increase of profit at Rouen is accounted for by the circumstance that in the previous year reserves were made to meet claims on the company for damages, relating to an explosion, attended with loss of life and the fall of a house in the Ile Lacroix. These damages and costs amounted to about £1400, and the present accounts appear comparatively better.

The returns from Boulogne and Nantes are favourable, and although those from Caen and Havre appear small, they must be considered satisfactory, in view of the general dulness of trade, which has for some time been experienced, even in towns that had not previously suffered. Notwithstanding this drawback, the consumption of gas is increasing at an average rate.

The prospective outlay referred to at the last meeting for purifying apparatus and a station-meter at Nantes and Rouen has been delayed for a short time, but your directors found it absolutely necessary to take measures to provide a new telescopic gasholder for Havre. This is now in course of construction, as also a second lift for one of the Nantes gasholders.

The prices of coals and rates of freight continue low, and your directors have recently entered into contracts on terms advantageous to the company's interest.

On the other hand, it must be stated that a reduction in the price of coke has to be submitted to occasionally, although the value of this product is, on the whole, well maintained.

Summary.—The total net profits of the six stations for the year ended March 31, 1875, were £53,368 3s. 11d., and on March 31 last, £56,336 7s. 6d., showing an increase of £2968 3s. 7d., after making full reserves for depreciation, and every contingency likely to occur.

The amount of net revenue for the year will admit of a dividend at the rate of 10 per cent. per annum on the entire share capital of the company, less 4 per cent. paid *ad interim* on Feb. 1 last, leaving a balance of £1311 6s. 9d. to be added to the reserve of undivided profits.

In recommending a return to the former rate of dividend on the present capital, increased by allotments of past accumulations of profits, your directors feel justified in congratulating the shareholders on the continued prosperity of the undertaking, which was never in a more sound and flourishing condition than at the present time.

Mr. William Jones Lewis having resigned the office of auditor, the board, in accordance with clause 96 of the old regulations, provisionally appointed Mr. Edward Garey to fill the vacancy.

Notice has been given that two of your directors (Walter Thomas Fawcett, Esq., and Thomas Chaloner Smith, Esq.) and both auditors (George Harrison, Esq., and Edward Garey, Esq.) retire from office at this meeting, but, being eligible, will be proposed for re-election.

The CHAIRMAN: Gentlemen, the report which has just been read to you I think sufficiently explains the result of the working of this company for the last twelve months, as compared with the previous year's working. It will not, therefore, be necessary for me to detain you with any lengthened remarks upon the nature of the report or the prospects of the company. The fact that at some stations we have done remarkably well, while at others we have not been quite so successful, and at one, even, have been rather unfortunate, only shows the great advantage—or, rather, the wisdom—which has been brought to bear upon a company like this, in which there are several stations in various parts of the country in which the operations are carried on; so that, while from local circumstances the returns from one station or another may, perhaps, fall off, in others there may be a more prosperous condition of things, so that, when the whole are put together, the results may be pretty well depended upon year by year. The dulness of trade has certainly affected France as it has other countries, though hardly to the same extent, and the natural growth of the company's business has been sufficient to make up in the aggregate for any reduction in the consumption of particular establishments or particular towns. You will see by the report that, wherever it has been possible, we have deferred expending further capital. The increase of gas storeage at Havre and Nantes has been, however, indispensable, and we have made contracts for those important works at the most favourable time, we think, for the interests of the company. Altogether, I believe I may say that the business of the company is in a thoroughly satisfactory state. We are, this day, returning to the same rate of dividend we paid two years ago, before we increased the capital of the company by 50 per cent., a rate of improvement certainly more rapid than I had ventured to expect; and this has been achieved, after charging the revenue, as the report states, very freely with every expense which was necessary; many of the charges being such as some companies would debit to capital. So that I may say that there never was a dividend more fairly earned than that which we recommend you to declare on this occasion. Gentlemen, I know of nothing of very special interest at any of the stations that I need remark upon, and it is fortunate that it should be so. It is a great advantage, and a matter of great satisfaction to us, that we have had no disturbing circumstances, during the past half year, to distract our attention, and interfere with the regular discharge of the business of the company. Some of our debentures fell due on the 1st of this month, and we availed ourselves of the opportunity to reduce the rate of interest from 5 to 4½ per cent. All of them were renewed at the latter rate, with the exception of about £200, which, of course, was paid off. I hope we shall not find it necessary to exceed 4½ per cent. on our debentures for the future, and, unless the circumstances of the time at which our bonds have to be renewed demand it, I hope we shall renew them at the same rate. It is with much regret I heard that our former auditor, Mr. Lewis, had resigned office owing to ill health. The board, acting under the power conferred upon them by the 96th of the old regulations, appointed, provisionally, Mr. Edward Garey to fill the vacancy. He is a gentleman well qualified, by experience of the accounts of other gas companies, carrying on operations in France and elsewhere, to discharge the duties of the office, and it is for you to say, by re-electing him at this meeting, that you approve of the choice we have made. I will now, with your permission, move—"That the report of the directors now read be received and adopted," and, before I put this motion to the meeting, I shall be glad to hear the remarks of any shareholder, and will endeavour to answer any inquiries to the best of my ability.

Mr. FAWCETT seconded the motion.

A SHAREHOLDER: Have the directors any idea of calling up the £2 10s. on the middle-class shares?

The CHAIRMAN: Not at present.

The motion was put, and carried unanimously.

The CHAIRMAN: The next resolution is—"That a dividend at the rate of 10 per cent. per annum be now declared on the shares of the company, according to the amount paid thereon; and, an interim dividend at the rate of 4 per cent. having been paid on the 1st of February last, that the balance, at the rate of 6 per cent., for the second half year, be paid on the 1st of August next; the whole out of interests and profits, and free of income-tax."

Mr. FAWCETT seconded the motion, which was at once adopted.

The CHAIRMAN: My next duty is to move the re-election of Mr. Thomas Fawcett as a director of the company. Mr. Fawcett has been a director for a great many years, and his services have been of much value to us in every way.

Mr. STOKES seconded the motion, which was put and carried.

The CHAIRMAN: I now move that Mr. Thomas Chaloner Smith be re-elected a director. All those who have the pleasure of Mr. Smith's acquaintance must know that he is a very great acquisition to the board of this company. He is one of the largest shareholders in the concern, and I feel that it is a great credit to the company to have a gentleman of his knowledge and experience on the direction of its affairs.

Mr. ROAN seconded the motion, which was put and carried.

Mr. CHALONER SMITH: Allow me, gentlemen, on my own behalf, and on behalf of my brother director, Mr. Fawcett, to thank you for the honour you have done us in re-electing us directors of the company. I can fully endorse what our chairman has said in reference to Mr. Fawcett, but I can hardly accept

the very kind remarks he made in reference to myself. However, I am, in point of fact, a very large shareholder, and I believe I am one of the few remaining who have been connected with the company from its origin. My father was an original shareholder, and almost all the shares that he ever held in the company are still held by myself and other members of my family. In expressing my obligations to you for the honour you have done my colleague and myself, I can only say that so long as we continue to have a seat on the board we shall do our best to serve your interests.

On the motion of the CHAIRMAN, seconded by Mr. SOLOMON, resolutions were passed re-electing Mr. Harrison and Mr. Garey as auditors of the company.

Mr. HARRISON acknowledged the compliment thus paid to the auditors.

Mr. STOKES proposed a cordial vote of thanks to the directors for the admirable manner in which the affairs of the company had been conducted, and congratulated the meeting on the prosperous condition of their affairs.

Mr. ROAN seconded the motion, which was carried unanimously.

The CHAIRMAN: Gentlemen, it has been my pleasure for many years past to receive and acknowledge for myself and brother directors the expression of your satisfaction with our management of your affairs, as I do on the present occasion. The directors have made a point of sticking to business from the first day I became connected with the company to the present, and though we have had a good many ups and downs in our time, we have come out a very prosperous company; and looking to the fact that all our different concessions are now settled, there is a fair prospect that we shall go on prosperously for many years in the future.

Mr. STOKES proposed a vote of thanks to Mr. Backler, the general manager, for the valuable services still rendered by him to the company.

Mr. BADDELEY seconded the motion, which was put and cordially adopted.

Mr. BACKLER: I feel very much gratified by the vote of thanks so kindly presented to me. I have great satisfaction in being here to-day, after the alteration of the regulations, which were in some part specially directed to myself. I think I should fail in acknowledging the kindness I have received from you at all times, and especially at the last meeting and the present, if I were not to say how much I myself owe to the staff of the company for the success I have been able to achieve in the management of this undertaking. I have had occasion to mention before, that we have on our staff officers who have been with us for 38 and 40 years, and I think it is as much to their credit as it is to the credit of the company that that should be the case. Situated as we are, with the management on this side the Channel, and the operations of the company carried on upon the other side, if we had not there a staff of gentlemen of very great ability and integrity, do what we would here, we should not be able to achieve that which we have accomplished, and I think that, having accomplished so much as we have, affords abundant proof that we have been as well served there as we have been on this side. In acknowledging, therefore, your vote of thanks to myself, I do so also for the staff of the company, every man of whom as much deserves your thanks as I have endeavoured to do.

The proceedings then terminated.

TEIGNMOUTH GAS AND WATER SUPPLY.

LOCAL GOVERNMENT BOARD INQUIRY.

The Local Board of Teignmouth, having made application to the Local Government Board to borrow £6000 for the purpose of making additions to their gas and water works, and to effect some other improvements, Mr. R. MORGAN, one of the Inspectors of the Board, held an inquiry into the circumstances, on Wednesday the 5th inst.

The petition of the board, read by the clerk (Mr. Jordan) stated that the proposed improvements at the gas-works consisted in the building a river wall, providing new gasholders, new purifiers, &c.; and there would be new works and buildings at the Coombe Water Works, laying gas and water mains in the Landcore, Brimley, and Buckerige Roads, also new sewers, and constructing a mortuary. The total debt of the board was £21,253 6s. 8d., borrowed for a term not exceeding 50 years. Of this capital £133 6s. 3d. has been paid off, leaving £21,120 still due. The rateable value of the parish at the time of this petition was £24,713 3s. 4d.

Mr. BEVAN, the chairman of the board, stated that the new assessment, on which the rate would be based, raised it to £27,000.

The CLERK said of the £6000 which they now wished to borrow, £3500 would be spent on the gas-works; £800 on the water supply; sewerage, and other similar works, £1500; improvements on the roads, £210.

Mr. BEVAN explained in detail the objects of the loan. Referring to the gas-works, he said that owing to the extension of building they were obliged to lay down extra gas-mains, and to erect additional public lamps. The pressure on the works had been so great, that in winter they had to work double time at large, extra expense of labour, and wear and tear of the works, so that, altogether, they had been going on under the most unfavourable conditions. It was proposed that they should extend their works by taking in a certain portion of the beach, and there erect an extra gasholder, which would hold 45,000 feet of gas, and relieve the works of much of the pressure now put upon them; they would be worked more economically, and the supply of gas would be better. They had hitherto endeavoured by cheeseparing—by putting out the lamps at an early hour, and not lighting them at all on moonlight nights—to save the gas; but people complained of this, and they now proposed to light the town in the same way as other towns were lighted. This extension made up a total of £3500. As to the water-works, the town had always borne a good name for its water, and they had been able to give a good supply when other towns of great importance had had to pinch. But to continue so good a supply as they had given hitherto, it would be necessary to have auxiliary power. After much consideration, it was thought that by putting up steam-pumping works at Coombe, they would be able to get over the difficulty. They had been obliged recently to hire a boiler, and that enabled them to supply from the Coombe works a good quantity of water. To carry out the proposed addition to the water-works would cost about £800. Other small items, added to the particulars he had given, would make up the £6000 they now applied to borrow.

Mr. T. DAND, C.E., of Exeter, pointed out the necessity for an extension of the gas-works. They had only half the storeage accommodation the requirements of the town rendered necessary, and, in order to maintain a supply, they had to carry on the works on a system greatly to their disadvantage. The whole of the neighbourhood, including the station and the signals there, were entirely dependent on the continuous satisfactory working of the apparatus; and should there be the smallest failure in any part, the town would be suddenly left in darkness. In addition to this risk, their present system of working involved the employment of a large additional amount of labour, and unduly strained their works. To prevent the possibility of the serious state of affairs—and for which the board would be responsible if anything happened to the works—he recommended the erection of a gasholder, 60 feet in diameter, which would hold 45,000 feet of gas, in addition to the 24,000 feet which they could now store. This would not provide more accommodation than was absolutely necessary, and there would be an ample return for the expenditure. The public would get a better and more regular supply, the apparatus would work steadier, and the gas would not be wasted. He had not recommended one penny expenditure that was not required.

In answer to the INSPECTOR, Mr. DAND said they nearly had a break-down some time since, and when any repairs were necessary they were driven to the most severe straits. He could not say whether the ratepayers would have cheaper gas, but the improvement would give a better result to the town, and if there was not a reduction in the price there would be at least a reduction in the rates. To provide a place for fixing the gasholder, the board had purchased a part of the beach adjoining the works, and they would enclose this with 240 feet of wall. On one portion there would be rather indifferent foundation, but the remainder would be on the rock. The wall would cost £1200. No more ground than was necessary would be enclosed, and when the works were completed they would be most compact.

Mr. STOOKE did not think that such a large gasholder was required. Some time ago Mr. Dand mentioned that a telescopic gasholder 50 feet in diameter would be sufficient to meet all the requirements of the town for the next 20 years, and he maintained that to fix a larger gasholder would simply be to throw away £400 or £500.

Mr. WILCOCKS, chairman of the Gas Committee, said owing to the exposed position of the works a telescopic gasholder would, from the repairs that would be necessary, be far more expensive than what was now proposed. He spoke of the great pressure on the works at present, and was sure they would do wrong if they did less than Mr. Dand recommended.

Mr. DAND mentioned that a telescopic gasholder would be twice the height of the one now proposed, and although those on the telescopic principle could be made so as to stand in the most exposed situations, yet they must be constructed accordingly. There was a steady increase in the consumption of gas, and he recommended the present plan because he did not think it too large for the requirements of the town.

Mr. MARTIN, C.E., explained the proposals with regard to the water-works. The £800 was intended to be applied in the purchase and fixing steam-pumps from the source from which already an auxiliary supply was obtained. The present supply was not, however, so great as was necessary, nor so pure as could be wished, whereas the present proposal would not only give the quantity they required, but it would give water of the best quality. The pumping machinery was tendered for by twelve different makers and a tender of £575 was accepted. He recommended the acceptance of this one because these makers were the patentees of the best kind of pump he knew; the board had now one of their pumps, which they could return, and the tender was very near his own estimate, which was £600. The house in which the machinery would be erected would cost about £150.

The INSPECTOR pointed out that if this pump was constantly at work it would pump 300,000 gallons per diem, or three times the quantity that would be required.

Mr. BEVAN said unless these works were executed the town would be without water—there was no doubt about that.

The WATER BAILIFF said before the pumping commenced last Wednesday night he had not above 2 feet left in the reservoir for the town.

Mr. HOLCOMBE said five years ago in 24 hours the town consumed 216,000 gallons of water, and the population had increased 10 per cent. since then. To meet the present requirements of the town it would require ten hours continuous pumping by the machinery Mr. Martin recommended.

Mr. STOOKE strongly opposed the proposed expenditure—the pumping-engine now at work was quite sufficient for the requirements of the town. There was no town in England with a better supply, or better quality of water. The outlay, to keep this new engine in order, would be enormous. The higher levels did not want any great increase to the present supply. He remarked, too, that the pipes had been down many years, and with the pressure of the water this pump would send through them, they were very likely to burst almost immediately. This proposed work would be simply "heaving away" the money of the town—it would be wanton waste. All that was required was a steam-boiler.

Mr. MARTIN did not anticipate any great wear and tear of the pumps, for they were made to stand a pressure of 500 pounds to the square inch, whereas the pressure that would here be put upon them would be only 150 pounds. As to the pipes, they were made many years ago, when the ironmasters were not so sparing of the quantity of iron they put into piping; and as pipes that were even now made were constructed to withstand a pressure of from 300 to 400 pounds to the square inch, he did not anticipate that the pipes now down would give way before the 150 pounds pressure. The pump at the higher reservoir would not be simply an auxiliary, but it would economize the water in that reservoir, by being used to supply some of the high levels direct from the source. It was not proposed to work the pumps continuously, as it was undesirable to work them at night and on Sundays, and, therefore, the pumps would not be too large for what was required of them. He had heard that unless the lower reservoir was kept brim full, they could not supply some of the houses at the lower levels.

Mr. STOOKE said that was because the supply was not properly regulated. With a little management in the turning of valves that could be got over.

The WATER BAILIFF said the houses supplied from the high-level reservoir paid £50 a year water-rental.

Mr. HUTCHINGS expressed his satisfaction at hearing Mr. Stooke bear testimony to the amount of water from the Coombe wells, because, last year, he prophesied that they would get very little water there, and were quite deceived in their anticipations. He might say that this matter had been fully discussed at the board meetings. The present proposals had been carried by large majorities, though Mr. Stooke was not one of the majority.

The question of the construction of new sewers, &c., was then gone into, and the necessary plans having been handed in, the inquiry terminated.

The Inspector will make his report to the Board.

BRITISH ASSOCIATION OF GAS MANAGERS.

(*Continued from page 53*)

WEDNESDAY, JUNE 14.

At the opening of the sitting this morning, Mr. C. WOODALL, of London, read the following paper on

SUNDAY LABOUR IN GAS-WORKS.

In willingly acceding to the request of our President and other of my friends, to bring the subject of unnecessary Sunday labour again under your notice, I am conscious of two principal difficulties—first, the subject has already been discussed at a meeting of the Association; and secondly, I have an impression that some, though possibly very few, members regard the question as one outside our proper sphere, as an assembly of practical men.

This last objection will, I am sure, vanish upon consideration. We give earnest and ready attention to any proposition for the improvement of portions of our machinery and apparatus; we will not withhold it from the welfare of those without whom machinery and apparatus can accomplish no profitable work. Again, if the profits of a gas company are made or lost as the work in the retort-house is well or ill done, and few will dispute the proposition, it is of importance to consider whether the course advocated is such a one as will, by injury to apparatus or otherwise, peril the chances of success.

As to the other point, I think the circumstances attending our previous discussion of the question both justify and require that it be further noticed. It is now six years ago that Mr. Morton read a short paper on Sunday labour in this room. The proposition that such labour was to a large extent unnecessary, and therefore should be diminished, came as a novel idea to the majority of the audience who listened to it. Further, the number of those who had taken any practical step in the direction indicated was so small that a discussion of the proposal, with any degree of thoroughness, was impossible. It will be in the recollection of the members that, after some most cordial remarks, the meeting requested a committee to report upon the matter. That committee issued a series of questions to the managers of all the works represented in our

Association, intended to ascertain—first, whether the sympathy of managers generally was with those who desired to diminish Sunday work; and secondly, where that sympathy existed, how far it had been possible to give practical effect to it. The replies to those queries showed a degree of interest in the matter that was worthily responded to by the report presented by the committee. Many had already done much in the desired direction; others would, but feared to do harm to their retorts. It was to the latter, and to those who, whether avowing it or not, yet felt that the harm done would outweigh the advantages, that the committee specially addressed their report, setting forth the means by which, in their opinion, the greatest amount of labour could be dispensed with, and a minimum of risk incurred.

Having made this short statement of what had been done to the time of the committee's report (1871), permit me to notice some incidents of the subsequent history of the question, and then to refer to the difficulties and objections that have been raised, and attempt to answer them.

It was most unfortunate that in the year following the committee's report the matter of Sunday labour and its reduction was pressed into the service of the stupid and mischievous men who advised the strike of stokers in London; unfortunate, because it was so natural that there should be a decided repugnance, on the part of managers, favourably to consider any matter thrust upon them in such offensive guise. There was also a feeling on the part of some (the engineer of one company wrote me to that effect), that the action already taken had suggested discontent to the men. Now, it is worthy of note, that from the men who used this question as a cover for their evil course, we heard much more about double pay for Sunday, than about relief from work, and the importation of Sunday into the quarrel did not alter the fact that, so far as the movement had a motive, it was entirely one of wages. Further, some managers found when, as was generally conceded about the time I refer to, increased pay was given for the Sunday work, that the men preferred to stay in the retort-house and draw the large wages, rather than take the relief from work. Although such has been the experience of some, I have no hesitation in saying that, with a very large section of the men, there has been throughout a thoughtful and intelligent conviction that it would be well for them to keep a rest-day once a week, and a loyal readiness to bear their part in the change by forfeiting the pay they would otherwise earn. In my own experience, I have never once seen any disposition of a contrary character. I remember with much satisfaction, that when increased pay was granted generally for Sunday work, my stokers did not stand out for it. I told them that I feared such an increase would be a temptation to many to desire a continuance of Sunday work, and so hinder what we were aiming at, and they agreed with me. This conduct was not confined to one or two works, but was found, I believe, wherever the men felt confident that every effort was being made to help them to relief from Sunday work. If we look at this action of the men from their own stand-point, it really exhibits a large amount of self-sacrifice.

My paper may, in some respects, have a family resemblance to a sermon,—I will increase it by a "personal application." How many of us, after being used to a certain income, would consent to a reduction of it by, say 8 per cent., unless we felt there was urgent need for the change which caused it, and yet this is what the stokers do. One other word about the time I have referred to. I think it quite possible that the successful attempts to reduce Sunday work, which had been made in certain London works, accounted for the existence of as much of fellow-feeling between employers and employed, as saved both from the miseries that were experienced elsewhere at that time.

I believe that now the practice is generally adopted in all the London works of suspending gas-making from 6 a.m. to 6 p.m. on Sundays whenever possible, and I trust that we shall hear to-day that an increasing number of country works are adopting the same rule.

The plan followed is generally the same as that advised in the report to which I have already referred. Where a weekly change is adopted, the gang leaving work at 6 p.m. on Saturday return at 6 p.m. on Sunday, those leaving at 6 a.m. on Sunday return at 6 a.m. on Monday, each being off for 24 hours. In my own case we prefer a fortnightly change, and consequently, in alternate weeks, one gang has 56 hours off and the other works on. As the charges are gradually burned off on Sunday morning, the exhauster is eased, and stopped when the gas is no longer fit to put in the holders. That remnant is then allowed to escape, by plug-holes, from the hydraulic main.

When it is possible to close up the furnace door and ash-pan, so that there is no in-draught to the setting, the consumption of fuel required to maintain the heat is very slight. At the South Metropolitan works, where the retorts are on the ground-floor, plates are laid across the ash-pans, and breeze heaped over the frame, the chimney dampers closed, and no attention paid to the fire till about 3 p.m. At my own stations for some time (the retorts being all built on the stage plan) the night firemen left undone their last clinkering, filled up the furnaces with coke and breeze at about 4.30 a.m., bricked up the door and ash-pan, closed the main dampers, and so left matters till the day men came in at one o'clock. The bricking up was a rather cumbrous process, and the waste of bricks considerable, so we now leave that out, and bring in the day firemen at 11 a.m. Of course, when the fires are left for eight or ten hours, it is indispensable that any current of air shall be prevented getting through them, otherwise the fuel is burned out, and a very perceptible diminution of the heat is apparent at night.

On the works of the Crystal Palace District Gas Company, a plan is followed which is, in some respects, entirely peculiar. I will note it very briefly, because I trust Mr. Watson will favour us with the details of his procedure. On those works for four months in the year (the summer months), the suspension of work is for 24 hours instead of 12, and the last charge is put into the retorts not at 5 a.m. on Sunday, but at 11 p.m. on Saturday. The night men go on duty as usual at 6 p.m. on Saturday, and work a half shift, all leaving before midnight, they resume work at 12 midnight on Sunday, and work another half shift, thus being off 24 hours. The day men who leave at 6 p.m. on Saturday resume at 6 a.m. on Monday, thus both gangs work six days each week. For the remaining eight months in the year the work is stopped for 12 hours, as in the case of the other companies. Mr. Watson has all dampers closed when the last charge is in, uses coarse breeze for maintaining heats, and estimates the cost of this most thorough-going suspension at £500 per annum for his large manufactory producing 400 millions per annum. This does not include interest on additional plant required. I feel that much is due to Mr. Watson in this matter for showing, by this 24 hours cessation, how little need there is to fear injury to retorts or apparatus when proper care is exercised. The manufacturing accounts of the Crystal Palace Gas Company will sufficiently reassure any manager, who may have fears on this head, about embarking on a similar road.

In one respect I think the plan I have named is open to objection. I have always been told by my foremen that it is difficult to muster the men for a six hours turn, and in this case, the same gang has two such turns within 36 hours. Again, the going to work at midnight on Sunday involves the necessity of spending the afternoon in bed. My own feeling is, that a rest from 5 a.m. on Sunday, to 6 a.m. on Monday, would give the men a truer Sabbath, using the word in its literal sense, of rest-day.

I have no doubt that Mr. Watson, in arranging as he has done, has been influenced by the desire literally to "keep holy the Sabbath day," a purpose with which I am sure very many, if not all of us, will thoroughly sympathize. At the same time I must express my opinion, that in this matter I feel more disposed to obey the spirit than the letter, and that I should more consider, and rather follow, the plan which gave the greatest relief to the men, than that which enabled me to conform most closely to the popularly accepted bounds of the Lord's day. I say this in no captious spirit; and while saying it, I feel the sincerest admiration for the course pursued at Sydenham. I merely wish to explain the object I would keep in view always in this matter—viz., to get for the men as much real rest-time as the time of suspended gas-making will allow. Permit me here to say, once for all, that I should take far less hearty interest in this movement, if I thought it unlikely even that the hours of rest on Sunday would be used by the men for those great purposes of worship and preparation to which Christian people have ever devoted it, and in which, beyond all comparison, is found the truest and most perfect rest, physical and mental. At the same time, before this Association, I can safely leave such matters, and trust for argument to the political and social side of the question.

It is often said that we should do well to keep our stokers at work on Sundays, until that happy time comes when the public-houses will be closed throughout the day. My impression is, that liberating the stokers will not delay that event. I do not think that any other than a very small minority of the men spend their leisure time on Sunday in drinking. We *very* rarely see a drunken man on the works on Sunday night; and there is among working men a large number who recognize that the Sabbath should be a rest-day for the nation, and not for particular classes or trades, and who, therefore, desire and work hard to procure the removal of all temptations to its desecration. Among such are many, probably, who would even resist the temptation to hear a favourite preacher, if he held forth out of walking distance from their homes.

A far more real objection to the cessation of work on Sunday is that named by our esteemed President of last year—viz., that such cessation involves the necessity for increased capital expenditure, and also adds to the expenses of working. We have, in recent years, and, I think, especially in London, been striving so hard to produce and sell gas at the lowest possible rate, and our accounts are subject to such examination and comparison, that the addition of 1 per cent. to the fuel account, or a farthing per 1000 to the item of wages, is matter sufficient to call for explanation, and to make the engineer dread the appearance of that pretty, but tantalizing book in red cover, the advent of which is now an important event in each season. That this race is entirely wise I very much doubt; and there are points about it that are, in my opinion, both ridiculous and mischievous. Into that I need not now go further than to say that I regard any such argument as being entirely inapplicable to this matter. I think we have a right here to regard the pecuniary as being a consideration secondary to our duty to our men and to society. But to what does this obstacle really amount? I have already admitted that we cannot expect to make in 6½ days the same amount of gas now produced in 7 days, therefore it is necessary to extend the gas-making plant, and we will take that extension at the full amount for 12 hours stoppage, say 7 per cent. Let us take the case of a company which require to set aside for dividend 10d. per 1000 feet, out of the price charged for gas; I believe it will be found that that 10d. would be just about divided in two if the capital expenditure had stopped at the inlet to the gasholders. We may, therefore, take 5d. per 1000 as sufficient, and it is more than sufficient, to pay interest on that part of the plant which would need extension; 7 per cent. on that gives ·35d. per 1000 as the extra charge upon the gas on this head. We now come to working expenses. Allowing the full number of firemen to be on duty, and that they receive full pay, the charge on this head, ·05d. per 1000, and an increase in the full account of 1 per cent. on the coal carbonized, all that is necessary with proper management, is equal to ·13d. per 1000. Putting together this ·35d. on dividend account and ·18d. on account of working expenses, it shows a charge against the working of ·53d. per 1000 feet of gas sold. Now, I maintain that this is a charge which cannot be held to justify the continuance of a custom so objectionable and injurious; but, at the same time, I maintain that it is a charge which, while demonstrable in figures, would not be experienced in practice for the following reasons:—First, almost all gas companies cut their producing plant too close, and are losers through having, at the time of greatest demand, occasionally to stint the supply to their consumers; secondly, and chiefly, from men refreshed by a Sunday's rest, and lifted from the condition of mere working, sleeping (and drinking), machines, we should get superior work, and more of it in the time they do work, and less of that waste due to the indifference with which so many go about their monotonous round. We know from our own experience, and from universal testimony, how much more productive is the labour of men vigorous in health and cheerful in mind, to that which is put forth when mind and body are jaded by too prolonged exertion. This is so, even where the mind is engaged with the hands; how much more will it obtain when the exertion is only physical, and knows no variety. Under such circumstances, life becomes a condition to endure, not to enjoy, and it would be a wonder were it otherwise than that the chief concern of the workman should be to reach leaving-off time. Do not suppose that, in speaking upon this matter, I am influenced by the specially laborious character of the stokers labour; on the contrary, I think it more than probable, as I have already said, that when the Sunday work is abolished, they will be able and willing to do a larger amount in the time they are on the works, and so reduce the proportion now spent in lounging about doing nothing. It is a strong argument in favour of the economic advantage of the Sunday, that England and America, where the day is most honoured, should be the most successful manufacturing countries. The grasping disposition which leads a man to work on and on through the hours that should be devoted to rest or mental culture will, in time, wear out his powers. And so with nations. The fear to do what is right, lest another should pass us in the race, betrays not only cowardice, but unwisdom. The man of method, who determines that within certain hours his work shall be done, so that the remainder may be his own and his family's, is more likely to be successful than the other, who persuades himself that he has always plenty of time, because he can take it from that which should be otherwise occupied.

Mr. Brassey tells of Russian labourers, working for themselves, who start at 2 a.m., and finish at 9 p.m., working about 17 hours per day, and yet accomplishing about one-half the work that an English labourer would perform in 10 hours. This may be due partly to superior strength—I am not aware that it is; but it is owing principally to the lassitude that must accompany such injudicious working. In the same way, the continental workman, in seven days, gets through no more work than we do in six, and I firmly believe, no more than he himself would get through in six, after a few months practice. Influenced by such reasons as these, I feel confident in advising the cessation of Sunday work even to those who are determined to consider first the question of cost.

One word, in conclusion, upon another aspect of the evil. There is no doubt the practice of gas-making on Sunday so accustoms us to work on that day, that we find it very easy to order and arrange for work of other kinds. Mr. Morton declined to speak of work other than carbonizing, holding it to be, I suppose, too bad to argue about. Now I would rather (and so, I think, would we all) with the help of a few men on Sunday, while the great bulk are at rest, make good some failure which needs the stoppage of the works, than run the risk of keeping the majority at work gas-making on Sunday in order to stop for repairs on Monday. But these necessary repairs are few in number, and occur but seldom, while the calling in of the mechanics on Sunday is, in many works, of frequent occurrence. I think it will be agreed that this practice is so slovenly, as well as unkind, that we should strive hard to wipe it out. A gentleman at the head of an important gas undertaking told me when, as a boy, I went over his works with him, that he found the quiet of Sunday a great

help to him, because he used it for the making up of his books and reports. For some fifteen years further the same unwise, though unceasing labour was kept up, and then that gentleman had to resign his position because the undertaking had gone backwards instead of improved, and those same books and accounts which had had the benefit of quiet Sundays, were, and had long been, in utter muddle.

If the manager himself respects the day, and uses it aright, he will be able to afford the advantage of it to his men also, and I feel sure that he, himself, his men, employers, and profits, will be the better for it.

I trust that I have not occupied too much time in again introducing this, to my mind, very interesting question, to your notice. It is one that admits of few figures, though, possibly a large amount of argument. We are now, at any rate, in a position to compare notes on the two sides; some of us have had a fairly long trial of the plan, and are certainly not disappointed or disposed to go back from the twelve hours rest. Many here have not yet tried what they can do, and others have tried and given up. Probably this is the last time we shall formally discuss the matter as an Association; I hope, therefore, that, valuable as our time is, at these too short meetings, members will spare enough of it so to ventilate different opinions as to put the matter thoroughly and clearly before the meeting, and then we must, of course, leave to every man's conscience the course he may elect to take.

Mr. Hislop, of Ayr, said that he was desirous of warmly recommending the paper just read to the attentive consideration of the members of the Association. It was about eleven years ago since he first commenced the systematic cessation of Sunday labour in the works under his charge, and he could bear testimony to the fact that the change thus introduced had been a real blessing to the men. When he came South and witnessed the way in which Sunday was observed in this part of the kingdom by many, it did not surprise him to find that the cessation of Sunday labour was a general practice; but it would surprise many present to be told that, notwithstanding the strictly Sabbatarian views entertained in Scotland, the cessation of Sunday labour in gas-works was not general there. He thought this was a subject which should commend itself to the attention of all the members, and, as Mr. Woodall had suggested, this might be the last time in which it would be specially brought forward, he trusted that those who had tried the plan, and realized the benefits it ensured, would fulfil the duty they were under earnestly to press the matter upon their brethren, until what was now the majority would become the minority in reference to the adoption of sunday rest.

Mr. Fraser, of Inverkeithing, said, like his friend, Mr. Hislop, he felt highly delighted with the paper just read. It was a most excellent, practical paper, and would surely commend itself to every member of the Association. He rose, however, just to mention a kindred matter. Scotland was a large iron-making country, and at one time all the blast furnaces were kept in full work during the Sunday, and it was contended that if the works were stopped, even for half a day on Sunday, the manufacturers would not be able to make iron again until the middle of the following week. At last some persons tried the cessation of Sunday labour, and found there was no difficulty in keeping the furnaces hot, so as to enable the work to proceed as usual next day. This showed that "where there's a will, there's a way."

Mr. Anderson, of Bath, warmly advocated the adoption of the plan recommended by the writer. He believed that every manager would admit that it was a good thing if it could be done, and the experience of those who had practically given up Sunday labour proved that the difficulties sometimes apprehended were not such as to justify the continuance of a system which, on the highest moral and religious ground, ought to be abandoned.

Mr. Eldridge, of Richmond, said he entirely sympathized in the remarks which had been made, and believed that it would be impossible to over-estimate the great blessing which Sunday rest would be to the men. But there was one little difficulty he felt in connexion with the matter, and he should like to ask some of his fellow-members how he was to get out of it. He found that Mr. Woodall and other managers in London did not pay the men for Sundays, and, in a certain sense, it might be fair to say, why should the men be paid who are not at work? But then the agreement made with stokers was for weekly wages of, say, 30s., and by that was always understood a week of seven days; but, if the plan proposed by Mr. Woodall were carried out, there would be only six days work, and the wages would be reduced to about 26s. If he proposed to do that, he knew very well that his stokers would tell him he might do the stoking himself, as they would not accept such terms. Of course, the difficulty might be got over in this way—by increasing the weekly wages to 34s., and knocking off a seventh for the Sunday on which the men were not employed; but then, how did they get over the financial question? He was, therefore, obliged to look at the matter in this way—regard the weekly wages of 30s. as the pay for seven days work, and if he could ease the men at all on the Sunday he would do it.

Mr. Bickerton, of Goole, said he rose to offer a remark, because the paper seemed so much to fit in with his endeavours for the last five years. When he first went to the works he now managed, the company were making about 11 millions per annum, and they were very much crippled for holder room; notwithstanding this, however, and the rapid increase that was taking place in the consumption, it was one of his first endeavours to put a stop to Sunday labour. He, therefore, gave himself no rest until he obtained another large gasholder, and as soon as that was constructed and brought into operation, he dispensed altogether with Sunday labour at once. He was bound to say that the result had been in every way satisfactory. He did not think for a moment that the company sustained any loss by the change, because the men worked more skilfully and heartily after a Sunday's rest than they did without it. Last year, when he began to pay off for the winter, he had some difficulty in getting men to remain for the summer months; but this year every man would be willing to remain, seeing that the Sunday was a day of rest to them. He paid them their wages just the same as though they worked for seven days a week, and he found that it answered very well indeed. He looked upon the movement for abolishing Sunday labour in gas-works as a step in the right direction, and wherever the opportunity offered, would endeavour to promote it.

Mr. Simpson, of Rugby, said he had been for 30 years connected with gas-works, and for 20 years of that period he had dispensed with Sunday labour as much as possible. For the last seven years it had almost entirely ceased at his works, and when from any circumstance it had required to be done, he had experienced great difficulty in getting the men to undertake it. They found the advantage of the system, and if there was not sufficient gas in store to carry over the Sunday, they strove anxiously to make up the quantity on the Saturday. The way in which he got over Mr. Eldridge's difficulty was this—instead of paying the men 30s. a week, he gave them 4s. 6d. per day; that was a little more money, and the men accepted it willingly, working seven days one week and six days the next. He thought this was more a question for managers than men, and he believed that if managers came to see the propriety of abolishing Sunday labour, they would soon find means to accomplish it, and he was persuaded that if they heartily resolved upon it the difficulties would disappear before them.

Mr. Booth, of Middlesbrough, was convinced that Sunday labour ought to be, and could be, dispensed with. He had had the system working for the last thirteen months. When he commenced he was afraid he should not be able to carry it on through the winter, having only storeage capacity for 500,000 cubic feet to meet an average consumption of 800,000, but he was happy to state that during the whole winter not a single man was at work for twelve hours on the Sunday. He paid them the full week's wages, and did not believe he had lost anything by dispensing with Sunday labour.

Mr. G. Livesey remarked that every one knew how easy it was to find excuses for anything which was not wanted to be done, and this facility probably accounted for some of the objections raised against the abolition of Sunday labour in gas-works. He was in company recently with an eminent engineer, who was conversing with another engineer connected with large gas-works, upon this question, and the remark was made: "If you put it on the religious ground, I do not hold with you, because it is just as bad to break the Sabbath to the extent of 12 hours as 24." He (Mr. Livesey) observed, "Then you think it is as well to be hung for a sheep as a lamb?" "Yes," was the reply; "if you go on the question of principle, you may as well work 24 hours as 12." But then, he observed, men must be governed by circumstances, and if they were not able to cease working for 24 hours, it must surely be worth something to be able to stop for 12. The gentleman referred to replied, "What I want to impress upon you is, that the retorts must not be put out; keep the retorts going; give your men all the rest you can, but do not let the retorts down and thus injure your works." He (Mr. Livesey) disputed the proposition, and maintained that if proper precautions were taken, the injury, if any, was imperceptible. He knew that in his own case he could not discover any injury to the retorts whatever. Of course, if the retorts were neglected, injury would be done to them just the same as when in regular work; but by keeping the coke in, and excluding as much as possible the air from the beds, he did not believe they would suffer any injury at all. No doubt the adoption of the system involved some extra cost. They would have to work 14 beds, where otherwise 13 would do, and this, to a very slight extent, added to the expenses; but a great deal might be done in this matter in the way of reduction of cost. He found in his own case, last winter, they were using a great deal of fuel on Sunday. The dampers were always closed on the top of the chimney, but still there was a great consumption of fuel. To obviate that, he tried the plan of filling the furnaces with breeze. The first thing in the morning he had a plate put over the ash-pan, and in some cases fine breeze was put on the plate, so as not only to check the draught of air at the exit of the chimney, but also to the inlet of the furnace. He was satisfied that if they could prevent any draught of air through the settings, there would be no diminution of heat during the 12 hours, and no wasteful consumption of fuel. Checking the current of cold air through the bed was the chief point to be attended to. As to Mr. Eldridge's difficulty, the answer he (Mr. Livesey) would give would be very much the same as that given by Mr. Simpson. He held that the right principle with working men was to pay them for the time they worked. A good many years ago the system was adopted at the South Metropolitan works of granting certain holidays. Once a month the stokers had a Sunday to themselves, and received their pay as though they were at work. This plan, however, turned out to be highly unsatisfactory, because the men received 14 days pay for 13 days work in the alternate fortnight. He had since altered that arrangement, and had increased the scale of payment, so as to bring up their gross receipts in the fortnight to the same amount. If Mr. Eldridge could get his men to work for 30s. a week, he was getting them at too low a rate for stokers in the neighbourhood of London.

Mr. Eldridge said the nominal wages were 30s., but there were certain extras which brought up the amount to 35s.

Mr. Livesey was sure that men could not be got for 30s. at Richmond, and had supposed the amount had to be increased in some way. He believed, however, it would be better to give it in wages absolutely, because the men at the Richmond works met men engaged elsewhere, and in conversation would call their wages 30s. only, taking no account of any extras. If the daily rate of pay could be increased, and extras abolished, it would be more satisfactory to the men, as well as to the manager. With reference to an observation that had been made as to 18-hour shifts, he would suggest that that involved very hard work for the men, and he thought the difficulty might be met in some other way. At his works they used to work 18-hour shifts at one time, but since they had adopted the system of stopping during the 12 hours on Sunday, they never had occasion for resorting to the practice. One lot of men left work at six o'clock on Saturday night and came back at six o'clock on Sunday night, another set left at six o'clock on Sunday morning, and came back at six o'clock on Monday morning, and thus such long shifts as 18 hours were avoided. Another advantage of working in this way was this: In London, sometimes managers were very much pressed for gas during foggy weeks. They then had a larger number of retorts at work—about 7 per cent. more—than they otherwise would have, so that they were better able to meet the emergency than if they worked the seven days through. The system of Sunday labour in gas-works was on every consideration to be avoided, for it reduced the men's lives to absolute drudgery.

Mr. Miles, of Clitheroe, had lately adopted the plan of doing with as little Sunday labour as possible, but he experienced the same difficulty that Mr. Eldridge had felt. The men were glad to have the Sunday rest, but would not agree to have their wages cut down. He considered the matter over, and thought to himself that when the men were at work on Sunday, he also had to be there partially, to look after what was going on, and that when the Sunday labour was reduced, his own work was lessened also. But inasmuch as he would not, therefore, like to have his own income reduced, he did not see why he should expect it of the men, and he therefore resolved to go on as he was. The result of his experience was that the loss on the new system was practically nothing, and he intended to continue it.

Mr. Wilson said the real question was whether the game was worth the candle. His decided opinion was in favour of the affirmative. As a political question, every one expected that one day in seven should be devoted to rest. Every one felt himself refreshed by such a cessation from toil, and better fitted for the discharge of the week's duty. He could not understand why it should be supposed that gas-works were an exception to the rule. That there would be some little loss by adopting the Sunday rest system, he thought it would be very difficult to disprove; because the furnaces were alight, and the retorts were not being used. To a certain extent, there would be an escape of heat; but, no doubt, this could be minimized. But the adoption of the system was likely to lead to a great advantage in another direction. Too many gas-works were short of holder room, and the cessation of one day's make of gas per week would probably induce companies to face the question more readily of increased storeage. Ample gasholder room had proved to be very valuable to companies; it led to more economical working, and, therefore, he felt that anything that would tend to bring that question prominently before directors was in itself a benefit indirectly.

Mr. Paterson, of Warrington, said he had not the pleasure of hearing the paper read, as he did not reach the meeting until late, but from the discussion that had taken place, he thought the general feeling of the members was in favour of closing gas-works on Sunday. Now, to that principle he had no objection whatever, and he would say that those who were in a position to comply with the necessary requirements were perfectly justified in doing it, but he could not depart from the principle which he recognized last year—viz., that it was entirely a question of propriety, and not a question of positive duty. In truth, it resolved itself into a question of whether managers were so favourably circumstanced as that they could leave off working during the whole Sabbath or not. No doubt there were many who were absolutely in a position to do so; let them adopt the system. Others were so peculiarly placed that he had no hesitation in saying they were perfectly justified in carrying on their operations on Sunday exactly as on other days. For himself, he did not hold

those strict views in reference to Sabbath observance that some did, but he had every respect for the day, and was willing to do all in his power to reduce the labour of his fellow-men during its hours. His experience was not of yesterday in the matter. Twenty-five years ago he determined for a whole twelvemonth to adopt the system of partial working on Sunday. At that time he found his loss was very great, and that he could not by any possibility maintain the quantity of gas from the coal until the end of the following week, and he also suffered damage from the great leakage which took place from the retorts. Mr. Livesey seemed to think that by keeping the lids on, little or no injury was done to the retorts. He (Mr. Paterson) held a different opinion, and he had reason to do so, because since then he had again attempted to reduce the amount of Sabbath labour in his works, and the result was that it was not attended with the degree of success that would justify its continuance. Even by keeping the retorts quite closed, and allowing no admission of air, so as to take away the incipient carbon from the fissures of the retorts, he was convinced they would go down and crack. He was firmly of opinion that the only way to keep clay retorts thoroughly up to the mark of perfect tightness against leakage was to keep them constantly at work. He was quite sure that any one who would lay off for 12 hours, even with the greatest care, would find the make of gas considerably lessened in the early portion of the week. As a question of prudence, it might be well to suspend labour as far as possible, and out of respect to working men, to give them as much indulgence as possible, so as to mitigate the drudgery connected with gas manufacture, but that might be done by a plan of holidays. He gave seven days holidays to each of his stokers once a year; but he did not, on any account, consider it desirable wholly to suspend Sabbath labour.

Mr. COCKEY, of Frome, said he was very glad the discussion of this question had taken place. To him it was a very interesting subject indeed, and the only point which, after all, it seemed to him they had to consider was, whether Sabbath labour was a necessity. He was firmly convinced that nothing could justify it but absolute necessity. Gas was so essential to the comfort, convenience, and safety of the community, that in its manufacture, if anywhere, surely a justification for Sabbath labour could be found. But speaking in reference to a class of works, such as he had the care of, where the production was about 20 millions a year, he thought it might be dispensed with. He had for several years carried out the system of abolishing Sunday labour almost entirely, though it could not be done away with altogether. Lamplighters, for example, must be employed to go round and light up the district in the interest of the public. As to the question of profit, he did not think they had any right to consider that in gas-making, any more than in any other manufacture. Speaking of his own works, and the system he had carried on there, he thought he might regard them as entirely successful; as during the whole of the panic they continued to pay their 10 per cent., although the price of gas was not raised more than 5d. per 1000, and they did not touch the reserve-fund beyond £100, which showed clearly that profits were to be made at a very moderate price for gas—their charge being only 3s. 9d. on the average—and that success might be obtained while abolishing Sunday labour almost to the full extent. At first he confessed to a little disappointment as to the effect upon the retorts; but a little practice enabled him to overcome every difficulty in that respect. The effect upon the men was most satisfactory. They knew that if they produced sufficient gas to carry over the day, they could have the time for rest; they appreciated this advantage, and they were the better fitted by it for resuming work on the following day. As the result, then, of his own personal experience, he felt sure that if those, at all events, who were engaged in works of the same size as his own, would turn their attention to the subject, they would soon realize the comfort and convenience of the arrangement, would be gratified with the improved habits and morals of the men under them, and would find that no material injury was done to their works.

Mr. BARRETT, of Grantham, thought the first move should be on the part of the men. If the stokers were to begin petitioning the managers, and show that they felt it their duty to work during the six days of the week in such a manner as to render the seventh day's labour unnecessary, he had no doubt that the plan would soon be adopted; but, unfortunately, the men in many places cared so little for the Sabbath that when arrangements were made for giving them rest from their work upon it, they employed its hours in demoralizing themselves and beggaring their families. He had himself tried it in more than one instance, but instead of the men coming back at 6 o'clock in the evening, sober and refreshed by the cessation of their labour, it turned out that they had spent their time in some low beer-house, and were in a worse condition to enter upon their night's work than they would have been had they been toiling all the Sabbath day. With every desire to alleviate the labour of these men, he felt that the move for the general cessation of Sunday work should come from them, and that it was their place to show that by diligence and attention to their duty, their services could be dispensed with during a portion, at least, of one day in seven.

Mr. WHITE, of Sherborne, contended, on the other hand, that the initiative should come from the managers, and not from the men. His practice was to pay the men for the seven days labour, and to tell them, "Make as much gas as is required for the Sunday on the previous day, if you wish to have the time for rest." The men took an interest in their work far more than they would do if they had no opportunity of an interval of repose, and the result was that he got as much gas per ton of coal now as he did before, and the men were cheerful and contented. He was satisfied that if the manager showed an interest in his men, they would soon learn to show an interest in him and his work.

Mr. CARR, of Halifax, said there was one point in this question which had been somewhat overlooked, and that was the effect upon the profit and loss department, and despite of all that had been said, this must not be entirely forgotten. He had had some experience under both systems, first in Lancashire, where the seven days system prevailed, and afterwards in London, where the rest day was allowed. When he came to London, he found that the social condition of the stokers was much higher than in the part of the country from which he came. In London, managers seemed to have the command of a better class of men—men who were more steady, and who were willing to do their work better. He was persuaded that if the work could be made more attractive, they would have better men applying for situations under them, and if they were to carry out the arrangement of ceasing from Sunday labour, the result would be in the end that the better work done in the retort-house would more than compensate for the small loss arising from the adoption of the system.

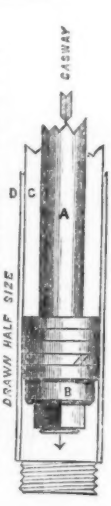
Mr. WOODALL said he was much gratified with the reception his paper had met with. He had felt considerable hesitation about bringing the subject forward, fearing, as he said, in his opening remarks, that it might be regarded by many as inappropriate for a meeting of this kind, in which the time at their disposal was necessarily short. He was glad, however, to find that so many members shared with him the opinion that it was a subject worthy of discussion. Then, again, he felt that he ought to experience some degree of shame in appearing as a kind of apostle of the cessation of Sunday labour, when he found that so many country friends had been so long before him in the field, and had been able to do so much more in this direction than he had been able to accomplish. With regard to the remarks made by Mr. Hislop, he might say that he very largely shared in Mr. Paterson's feelings. He was not a Sabbatarian in the sense of holding that there was an absolute obligation to keep the day as the Jews did, otherwise he should not be the manager of a gas-work. He believed it should be used in the way mentioned in his paper, the way in which Christian people generally used it, so as to get from its observance the most thorough rest. As to Mr. Eldridge's remarks, he would say most strongly they had no right to pay men for their time when they were not working. In his case the loss to the men would be 2s. 2d. per week, and he (Mr. Woodall) thought the rest was certainly worth that. He was glad, however, Mr. Livesey called attention to the fact that the money paid by Mr. Eldridge to his men was not 30s. per week, but something more. He believed it was a mistake to make up wages to a large amount, and only show a small one. He remembered, in his own case, some years ago, that when the men came to ask for an increase of wages, all the extra sums they had been receiving, and which, in the course of the year, amounted to a considerable figure, were entirely lost sight of by them, and therefore he was clearly of opinion that the whole of what they received should appear in their weekly wages. He could only reply to Mr. Eldridge's question by saying that he had never found, in the men working under him, any disposition to dispute the arrangement; they had always been willing to give up the day's pay, and, in point of fact, when he had required to have work done on the Sunday there was considerable difficulty in getting men to come in and do it. Mr. Livesey referred to a conversation he had had with an eminent engineer on this subject. It appeared to him that on that occasion Mr. Livesey had the advantage of speaking from experience, while the other was in the position frequently held by men who offer strong opinions upon subjects without any *data* to sustain them. Mr. Livesey alluded to a matter which he (Mr. Woodall) mentioned in his paper—that many gas companies do keep down their producing plant too closely, and, as a consequence, suffered inconvenience in the time of special demand, not having sufficient retorts to meet the claims upon their resources. Where the gas for seven days was made in six days and a half, there was always a certain amount of surplus, which was available in such circumstances as those Mr. Livesey mentioned. He was exceedingly glad Mr. Paterson had favoured the meeting with his opinions, although it was hardly necessary to say that he did not sympathize with them at all. At the same time, he was particularly anxious to hear from Mr. Paterson the manner in which he regarded the question. Mr. Paterson was one who had tried this plan, and had failed to secure that amount of success which would induce him to continue it. He stated that, as the result, there had been a loss during the early days of the week, and, indeed, until late on in the week. It was the experience, also, at Vauxhall at one time; they did not get up the full make of gas until nearly the end of the week. But then it was clear that, in the latter instance, this arose from proper care not having been taken in closing up the furnaces on the Sunday, or in attending to the furnaces when they were in work. He was perfectly certain, from practical observation, that there need be no loss whatever beyond, say, six hours from the commencement, and indeed he was not at all sure that there need be a loss even for that time. Mr. Carr, in his remarks, gave some valuable testimony to the social effect of the change of system, and to the fact that he found the stokers in London, where it was carried out, of a higher class than those in the country, where the seven days continuous labour was exacted. For his own part, he (Mr. Woodall) could assert that there was a most decided alteration in the manner and conduct of the men under his charge as the result of this change of system. A reference had been made, in the course of the conversation, to the question of gasholders, and also to the question of cost. And here he thought it was quite fair to point to the experience of the Chartered Company for the last two years. In their case, Mr. Trewby invariably stopped the works at Beckton during 12 hours on Sunday, and surely if difficulties would arise anywhere from an alteration of the general routine of work it might be expected there. He believed, however, that no mischief or inconvenience had arisen, and, indeed, Mr. Trewby found that, if not disposed to do so, the demand for gas was so reduced that it became necessary, or he would have to keep a much smaller number of retorts at work than would be safe for the supply of his enormous districts. A reference to the accounts of the company during the period mentioned certainly showed that they had not suffered in any material way as the result of the alteration in the system of manufacture, so far as the cessation of Sunday labour was concerned.

The PRESIDENT said he had already expressed his opinion upon this question so fully, that it was not necessary for him to add many remarks. The question of storeage had been brought up in the course of conversation. He referred to it because he believed that some who were anxious to introduce the system of a cessation of labour on Sundays might be deterred from commencing it by some remarks that had been made about limited storeage. As a matter of fact, it frequently happened that even where there was limited storeage, the managers had to stop their make on Monday, if not on Sunday, so that it was not a matter of storeage at all, and, therefore, any consideration of that kind need not stand in the way. He was glad to have heard Mr. Paterson's remarks, though he did not at all agree with him. Every one listened to Mr. Paterson with very much respect, and they could only hope, after what he had heard that day, he would try the experiment again, and with better success than hitherto had attended him.

(*To be continued.*)

In the report on Mr. Richards's paper in our last (page 49), Mr. Stout, of Boston, is made to say, in answer to the president, "that he had no cross-walls." Mr. Stout writes to say that the president's question was whether he *dispensed* with the cross-walls, to which the reply was, that he did not.

IMPROVED DRY SLIDE FOR GAS-FITTINGS.



The engraving in the margin represents a sectional view of an improvement recently patented by Mr. J. P. Lakin (No. 3490, Oct. 8, 1875), and manufactured by Messrs. Barwell, Son, and Fisher, of the Worcester Works, Birmingham. The object of the invention is the application to dry sliding gas-fittings of metallic packing, in the manner briefly described.

The apparatus is formed of three tubes, one within the other; the exterior tube, D, being intended simply to protect the second or middle tube, C, from injury, by blows or otherwise, that might interfere with the satisfactory working of the slide. The central tube, A, forms the gas-way, and upon its outer lower end is fitted a piston, B, formed of two plates or covers, the upper one of which is fixed, the bottom one being secured and adjusted by means of lock-nuts. Between these plates or covers are placed three or more metallic packing rings, each ring being cut in a bevelled direction, and of such a normal diameter as to have a constant tendency to spring outwards against the interior of the second tube, C, which is mandrel drawn. This tendency of the rings to spring outwards causes the tube in which they work to remain air tight, and the gas is thus securely prevented from escaping. Chandeliers fitted with these dry slides work as easily and noiselessly as with water slides. To prevent a too common accident with chandeliers, a cap or flange is fitted to the outside of the upper end of the tube C; so that in the event of a balance-chain breaking, the chandelier cannot fall, nor can any escape of gas take place.

GLASGOW WATER SUPPLY.—Dr. Mills, F.R.S., professor of technical chemistry in the Andersonian University, Glasgow, reports that the Loch Katrine water supplied to that city during June was nearly colourless, and somewhat ferruginous in character, containing "a few particles of iron scale."

ANALYSIS OF POTABLE WATERS.

By E. Frankland, D.C.L., F.R.S.

(*Continued from page 55.*)

The following data show the delicacy and accuracy of carbon and nitrogen determinations made in this way:—

To 100,000 parts of a sample of water, rendered as nearly chemically pure as possible, 1·5572 parts of sulphate of quinine were added. The following data compare the quantities of organic carbon and organic nitrogen thus actually added to the water, with those afterwards found in two analyses:—

	Present.	Found. 1.	Found. 2.
Organic carbon in 100,000 parts of water	0·857 part	0·912	0·904
Organic nitrogen in ditto	0·100 „	0·0996	0·098

To 100,000 parts of a similar sample of water, 0·7786 part of sulphate of quinine was added, and the following results obtained on analysis:—

	Present.	Found. 1.	Found. 2.	Found. 3.
Organic carbon in 100,000 parts of water	0·429 part	0·435	0·442	0·440
Organic nitrogen in ditto	0·050 „	0·047	0·048	0·048

To 100,000 parts of a third similar sample of pure water, 0·07786 part of sulphate of quinine was added. On analysis this water yielded the following numbers:—

	Present.	Found. 1.	Found. 2.	Found. 3.
Organic carbon in 100,000 parts of water	0·043 part	0·047	0·050	0·055
Organic nitrogen in ditto	0·005 „	0·006	0·005	0·006

The close approximation of the experimental to the calculated numbers is the more striking when it is remembered that the weight of nitrogen actually determined in the litre of water used for analysis was, in the last series, only 0·00005 gramme—a quantity which, if converted into platinum salt, would only weigh 8-10ths of a milligramme.

Applied to actual specimens of potable water, the accuracy of the method can be tested by the uniformity of results obtained in duplicate analyses of the same samples of water. The following instances will suffice to illustrate this point:—

	Results of Analysis Expressed in Parts per 100,000. 1.	2.
Thames water as supplied to London—		
Organic carbon	0·280	0·285
„ nitrogen	0·032	0·035
River Lee water as supplied to London—		
Organic carbon	0·231	0·239
„ nitrogen	0·042	0·042
Kent Company's water as delivered in London—		
Organic carbon	0·054	0·056
„ nitrogen	0·016	0·017

But, as practical illustrations of the trustworthiness of the process, these examples, if multiplied a hundredfold, could scarcely afford such satisfactory evidence as that presented by the results of the monthly analyses of the water delivered by the eight metropolitan companies, made for the Registrar-General during six years, and exhibited in the accompanying diagrams.

This diagram shows the mean proportions of organic elements (organic carbon and organic nitrogen) in the waters from the Thames and Lee, and compares them with that found in the deep well water of the Kent Company from 1868 to 1873 inclusive. It also shows, in five day averages, the rate of flow of the Thames at Long Ditton, nearly opposite Hampton Court Palace, and consequently near the place where the Thames Water Companies abstract their supplies. This last information is plotted from daily gaugings furnished to the Rivers Commission in 1874, by Mr. John Taylor, C.E.—the engineer to the Lambeth Water Company.*

Unfortunately no similar gaugings have been executed on the River Lee, but probably the rainfall and its effect upon the river flow are not very different in the two basins.

The Thames is almost invariably more polluted by organic matter than the Lee, whilst the water raised from deep wells in the chalk by the Kent Company is much purer than either, as far as organic matter is concerned.

The diagram shows how sharply the distinction between these three waters is drawn by the analytical determinations of organic carbon and nitrogen. In no instance does the curve representing the average organic impurity in the Thames approach near to that indicating the like impurity in the deep well water, whilst the curve of organic contamination in the Lee water intersects the Thames curve but twice, and the deep well curve only once in six years. Even these intersections are interesting as illustrations of the delicacy of the analytical method. That of the Lee and deep well curves occurred at a time when, through the defective storeage arrangements of the Kent Company, the deep well water was subjected to slight pollution from surface soakage. In April, 1868, I inspected the works and pointed out the defect to the late Mr. Morris, the engineer to the company. No intersection has since occurred.

The passage of the Lee through the Thames curve occurred very slightly in February, 1870, and again more decidedly in February, 1873, on both occasions after heavy floods. We have not to seek far for the cause of these exceptional intersections. At those dates four out of five Thames companies supplied from hand to mouth—they had no storeage, and consequently, though obliged to supply highly polluted water during floods, they instantly derived the advantage of a purer stream when the floods subsided. Thus the Thames water delivered in January, 1873, when the river was conveying 4200 millions of gallons daily, contained nearly twice as much organic matter as it did in the following month, when the flow of the river was only 1700 millions of gallons per day. On the other hand, vast volumes of the polluted water of the Lee had been stored by the East London Company during the heavy floods which prevailed from the beginning of December, 1872, to the end of January, 1873. The whole of this polluted water had not been distributed before the collection of the sample on the 10th of February, and thus the organic impurity in this flood water of the Lee exceeded in amount that present on the same date in the fair-weather water of the Thames.

The diagram also shows how faithfully the analytical results record the variations in the three great conditions which govern the intensity of organic contamination in river waters, viz.:—1. Heavy floods. 2. Small floods when the river is low; and 3. Decay of vegetation in autumn.

The effect of heavy floods in enormously increasing the pollution of the Thames is strikingly seen throughout the diagram, but it is especially exemplified by the abrupt rise of the Thames curve in the months of January, February and December, 1869; in January, 1870; in January, April, November, and December, 1872; and in January and March, 1873. Reference to the Lee curve shows that the organic matter in that river is simultaneously affected, but, as a rule, to a less violent extent.

* See sixth report of the Rivers Commission, 1874, p. 474.

Not only do heavy floods bring down the Thames a vast aggregate and much increased proportional quantity of filthy organic matter, but in dry weather a thunder shower, for instance, will sometimes wash into the river or its tributaries the polluting matters that have been accumulating for weeks in stagnant ditches and cesspools, and this without increasing the flow of the river to any great extent. In this way, a very small flood upon a low river will sometimes impart to the water a greatly increased proportion of organic impurity. In October, 1869, and November, 1873, the analytical curve of the Thames shows that the foulness of the water was markedly increased by such small floods. In the Lee this effect of small floods is much less conspicuous, owing to the large storeage reservoirs of the East London and New River Companies.

The plotting of these curves has also brought out the interesting fact, that the quality of the deep well water delivered by the Kent Company is not entirely, though it is nearly, unaffected by heavy rain. In the years 1868 and 1869, the apex of the deep well curve coincides with those of the Thames and Lee too frequently to be the result of accident. Whether this arose from the actual direct access of a small proportion of surface water to the wells, or from an acceleration of the process of natural filtration by surface pressure, cannot now be determined; but previous to the year 1872, part of the water was pumped into an uncovered reservoir, and was there liable to some amount of pollution. Since the covering and cementing of the reservoir, this effect has been barely, if at all, perceptible.

Independently of floods, the decay of vegetation late in autumn must obviously produce a decided deterioration in the quality of river waters; but as this decay often takes place simultaneously with the occurrence of floods, it is not often possible to isolate its effects. In October, 1868, and November, 1870, however, the Thames was low, and the separate result of decaying vegetable matter is clearly indicated by the abrupt rise of the analytical curve. A small flood at this time of the year, or soon after the "fall of the leaf," produces an enormous effect upon the quality of the water; thus late in November, 1869, a rise of the river from 500 millions of gallons to 930 millions of gallons daily flow increased the organic impurity by 57 per cent.; between September and Oct. 10, 1871, a rise of from 450 millions of gallons to 840 millions of gallons, which last number represents about the average flow of the Thames, to more than three times its previous amount; whilst in November, 1873, an increase of daily flow by only 330 millions of gallons augmented the organic impurities to double their previous amount.

The translation, into analytical numbers, of the effects of the chief conditions which determine the quality of the water derived from the Thames, the Lee, and the deep wells sunk into the chalk, is most clearly seen in diagram [exhibited], in which each kind of water is represented by a single curve; but it is also interesting to see how far the more minute differences of treatment which the three kinds of water receive at the hands of the eight London water companies are expressed in the determinations of organic carbon and nitrogen. For this purpose it is necessary to plot out a more elaborate diagram, in which the results of analysis yielded by each company's water are represented by a separate curve.

As the water from deep wells is delivered by only one company, the same curve represents this kind of water in both diagrams; but the water of the Lee is distributed by two, and that of the Thames by no less than five distinct companies; and, as the water of each company is submitted to monthly analysis, it follows that the average curve of the Lee must be resolved into two, and that of the Thames into five constituents. This decomposition of the river water curves distinguishes the diagrams from each other. In all other respects they are identical. The more elaborate diagram serves to illustrate the following points:—

1. *The Difference, in regard to Organic Impurity, of the Water Distributed from the Lee by the New River and East London Companies.*—The New River Company abstract the chief portion of their supply from the Lee at a point above the outfall of the Hertford sewage, and where in dry weather it consists almost entirely of spring water. They mix it with about one-fourth of its volume of spring water, and occasionally, though rarely, with a small proportion of water pumped from deep wells; but the volume of water, other than Lee water, distributed by this company is too small to affect materially the composition of the water delivered to their customers in London, although all these subsidiary supplies tend to improve the quality of the water.

The East London Company abstract their supply at Ponder's End, 14 miles lower down the river, and after the accession of much impurity which reaches the Lee below the intake of the New River Company. On the other hand, the East London Company possess much greater storeage capacity in their reservoirs, which enables them to close their intake during short floods, although they are obliged to take in water during long continued rainy weather.

The analytical curves clearly express these differences in the conditions under which the two companies work. The New River curve is generally below that of the East London water, and, with one or two notable exceptions, it crosses the latter only in very dry weather, when much of the filth, which otherwise finds its way into the Lee, is retained by an absorbent soil; and thus the river maintains a chemical character approaching to that of spring water, even down to the intake of the East London Company. The notable exceptions illustrate the effect of large storeage capacity upon the chemical quality of the water sent out to consumers. Thus between the collection of the samples in January and February, 1869, there occurred two heavy floods with an interval of fifteen days of good water between them. By taking advantage of their great storeage capacity, the East London Company rejected some of the bad water, and supplied in February a beverage of superior quality to that distributed by the New River Company, which have barely five days storeage room. A similar instance occurred in April, 1872, and another in March, 1873.

On the other hand, during the continuance of the imperfections in the Kent Company's works, the New River curve occasionally intersected that representing the organic impurity of the former company's water, but this has never occurred since the year 1870.

2. *The Difference, in regard to Organic Impurity, of the Water Distributed from the Thames by the Five Companies Drawing from that River.*—Of these five companies the West Middlesex is distinguished for the comparatively large capacity of its storeage and subsidence reservoirs, and for the perfection of its filtering plant. During the last eight years this company has never sent out water which was in the slightest degree turbid. Though water is drawn from the river every day, whatever its state may be, in times of exceptionally foul water the intake is reduced as much as possible. The company has storeage for about seven days supply. These conditions under which the West Middlesex Company works are faithfully recorded in the results of the analytical examination of the water. Thus the curve representing the proportion of organic elements sent out by this company is in times of flood always much lower than that of any other Thames supply; as is strikingly seen by a comparison of the curves in January, February, and December, 1869, January, 1870, February and October, 1871, January, April, November, and December, 1872, and January, March, and November, 1873.

But the West Middlesex Company cannot always avoid admitting flood water into its reservoirs, and when once let in, this water can only be again discharged by the distributory mains. It mixes with and depreciates the quality of the fair weather water which comes in after the subsidence of the floods. In fact, the storeage of river water, unless the reservoirs possess a much greater capacity than those of any of the Metropolitan Companies, is not an unmixed good; because the stored water is liable at times to be more polluted than that flowing in the adjacent river. The injurious effect of the West Middlesex storeage reservoir is exemplified by the curve representing organic impurity in June, 1869. In the preceding month samples of the fine-weather Thames waters were collected at the commencement of a flood, and all, except the West Middlesex, were much polluted. In the following month, however, the samples were collected from a

low river several days after the subsidence of a series of freshets. The West Middlesex Company was still distributing the flood water which it had impounded during the 30 days, whilst the remaining four Thames companies were drawing from a comparatively pure river. Thus these last companies distributed much better water in June than in May, whilst that sent out by the West Middlesex continually deteriorated from April to June. The same effect of greater storeage capacity again receives its analytical illustration in February and March, 1870, November, 1871, and February, 1872.

Of the remaining companies drawing from the Thames, the Lambeth and Chelsea alone abstract at a point below the junction of the Mole with the Thames. Partly on this account, but chiefly by reason of their inferior subsidence and filtration plant—the Chelsea Company has no subsidence reservoirs, and the muddy river water runs directly on to their filter-beds—the water delivered by these companies might be expected to be of inferior quality. An inspection of diagram No. 2 shows that the summits of the curves are generally capped by the representatives of these waters. This is conspicuously the case in January, 1868, December, 1869, January and November, 1870, February, 1871, January, April, November, and December, 1872, and January, March, August, and November, 1873. The inferiority of these waters would be still more conspicuous were it not for the erratic movements of the Southwark curve. The Southwark Company's district grows more rapidly than that of any other metropolitan water company. In January, 1868, it supplied only 14 millions of gallons daily, whilst in November, 1873, the daily delivery increased to 19½ millions of gallons. This is an inconvenient rate of increase. The company have from time to time made great efforts to keep pace with it, in their subsidence and filtration plant; and the curve of organic impurity represents the spasmodic struggles of Mr. Quick, the company's engineer, in this contest with dirty water. In January and February, 1869, he was hopelessly beaten; in May and October of the same year the curve again reaches the summits of the peaks, and not until December can the company stand the flood test. Then, however, there is considerable improvement until April, May, and June, 1871, when the demands of a thirsty population again demonstrate the insufficiency of the enlarged plant. Once more, however vigorous efforts are made, and throughout the rest of that and the two following years the company delivers water of medium quality.

3. *The Influence of the Date of Collection upon the Quality of the Sample.*—As a rule, all the samples of river water are collected on the same day of the month, but occasionally, owing to a failure in the stand-pipe from which the water is drawn direct from the main, the collection is delayed for a few days. Now if a flood occurs on the date of collection of the second sample, or on the previous day, that sample ought to be more highly polluted with organic matter. A case of this kind occurred in March, 1870. All the samples of Thames water, except that from the Chelsea Company's mains, were collected on the 2nd of the month, just before the occurrence of a heavy flood on the 6th, which increased the volume of the river to 2000 millions of gallons. The Chelsea sample was collected on the day after the flood, and the analytical curve shows how much more highly it was polluted by organic matter.

Not only, therefore, does this process for the determination of organic elements clearly define the differences between deep well, Lee, and Thames water, but it has also shown itself competent to reveal the finer shades of quality in waters drawn simultaneously from the same source, but treated differently by the various companies who manipulate them.

Against these advantages it must be acknowledged that the process involves more trouble and more careful manipulation than are usually bestowed upon what are called "commercial" analyses. Now although these drawbacks ought not to be paramount considerations where such important issues are involved, yet if any other more simple method existed by which trustworthy quantitative information about the organic matter in water could be obtained, the process which I have been describing would cease to have a *raison d'être*. I showed eight years ago, and my proofs have never been called in question, that the incineration and permanganate processes are quite useless; nevertheless the latter is still used by Dr. Letheby in his monthly reports to the Medical Officers of Health. But there still remains the albuminoid ammonia method of determining organic nitrogen. I need not describe this method, as it is well known, and is now almost as generally used by analytical chemists as were formerly the incineration and permanganate processes. This method depends upon the fact that by boiling with an alkaline solution of potassic permanganate, most nitrogenous organic bodies are decomposed with evolution of ammonia. But the total nitrogen contained in the organic bodies is rarely evolved as ammonia, and the proportion so evolved varies very widely when different kinds of organic matter are submitted to this reaction. The authors of the process indeed soon withdrew their statement, that albumin yielded all its nitrogen as ammonia by ebullition, first with potash and then with alkaline solution of potassic permanganate (*Jour. of Chem. Soc.*, vol. xx., p. 593), nevertheless the results yielded by this method continue to be entered in analytical tables as organic nitrogen, although its authors have never sanctioned such an interpretation.

An examination of this method must convince all that it is incapable of converting into ammonia either the whole or any definite proportion of the organic nitrogen of potable waters. The results obtained by the authors themselves, when they operated upon known quantities of organic matter, prove this most conclusively, as is seen from the following comparison of their experimental numbers with those calculated from the formulæ of the bodies operated upon; 100 parts of each substance yielded:—

	Nitrogen actually Present.		Nitrogen Found.
Asparagine	18·66	..	18·05
Piperine	4·91	..	4·45
Diamylamine chloride	7·24	..	6·53
Amylamine	16·09	..	17·96
Diphenyl tartramide	9·33	..	8·41
Gelatin	18·30	..	10·46
Casein	13·0 to 16·0	..	6·26
Albumin	13·0 to 16·0	..	8·24
Morphine	4·91	..	2·31
Codeine	4·42	..	2·47
Papaverine	4·12	..	1·81
Strychnine	8·38	..	4·49
Iodide of methyl-strychnine	5·88	..	2·74
Brucine	7·11	..	3·79
Quinine sulphate	7·51	..	3·71
Cinchonine sulphate	7·84	..	4·70 4·45
Nicotine	17·28	..	8·89
Naphthylamine	9·80	..	5·48 5·61
Toluidine	13·09	..	7·27 6·83
Rosaniline acetate	11·63	..	5·25 5·34
Creatine	32·07	..	10·38
Theine	28·86	..	7·03
Uric acid	33·33	..	5·76
Urea	46·66	..	0·00
Picric acid	18·34	..	0·00

Thus out of 25 nitrogenous organic substances experimented upon, only five yielded, approximately, the whole of their nitrogen as ammonia when treated by the albuminoid ammonia process. Of the remainder, some evolved one-half, others one-third, one-fourth, or even none of their nitrogen as ammonia. To this list may be added the results obtained by Dr. Armstrong and myself on submitting various nitrogenous organic matters to the albuminoid ammonia process. (*Jour. Chem. Soc.*, vol. xxi., 1868, p. 98.) We found that strychnine, when treated as directed by the authors, yielded rather more than one-third of its nitrogen as albuminoid ammonia, narcotine between one-third and one-half, quinine sulphate about one-half, and soluble peaty matter a proportion varying from less than one-third up to nearly one-half. Out of the substances of known composition which have thus been experimented upon, the following may be selected as of peculiar importance, because they are liable to be present in potable water—gelatin, casein, albumin, creatine, uric acid, and urea; and it will be seen, on reference to the foregoing analytical results, that these substances yield up, when treated by the albuminoid ammonia process, proportions of their nitrogen varying from more than one-half down to nothing. The total immunity of urea from the reaction is peculiarly unfortunate, because it is practically impossible to estimate the urea in a good potable water to which fresh urine has been added, by boiling with sodic carbonate; and yet the estimation of the nitrogen of urea, not to speak of its carbon, is of the utmost importance in the investigation of waters polluted by sewage. On the other hand, peaty matter, the presence of which in water is of comparatively little importance, yields up a large proportion of its nitrogen as albuminoid ammonia. It is, therefore, evident that this process can give no evidence whatever touching the proportion of organic matter present in potable water; whilst it is equally evident that it cannot even indicate the relative quantities of organic nitrogen in different samples, unless the proximate constituents of the organic matter happen to be of the same kind, and in the same relative proportions in the samples compared—a coincidence which must obviously seldom or never occur. Neither can the albuminoid ammonia process be used to indicate either the presence or the proportion of albuminoid, as distinguished from other nitrogenous organic compounds. This conclusion is not only rendered unavoidable by the experiments recorded above, but it is also established by the fact that peaty matter, either alone or as it occurs in water, yields abundance of so-called albuminoid ammonia, although the existence of protein compounds—so prone to change—in a material which has been exposed to air and moisture for thousands of years, is clearly an untenable assumption.

It is, therefore, not suprising to find that the application of this process, both to natural and artificially prepared waters, discloses wide discrepancies and great irregularities in the evolution of albuminoid ammonia that is in the estimation of organic nitrogen. The following examples, in which the nitrogen obtained as albuminoid ammonia is contrasted with that actually extracted from the waters by the combustion process, serve to show how the irregularities observed, in the case of nitrogenous organic compounds of known composition, are reproduced, when the, for the most part, unknown nitrogenous compounds in potable waters are similarly treated.

Results of analysis expressed in parts per 100,000:—

Artificial Waters containing Peaty Matter.

	Organic Nitrogen by Combustion.		Organic Nitrogen by Albuminoid Ammonia Process.
I.	·068 part	..	·016 part
II.	·042 ,,	..	·016 ,,
III.	·076 ,,	..	·022 ,,
IV.	1·015 ,,	..	·308 ,,
V.	1·175 ,,	..	·422 ,,
VI.	·029 ,,	..	·011 ,,

Natural Waters.

	Organic Nitrogen by Combustion.		Organic Nitrogen by Albuminoid Ammonia Process.
Chelsea Company's water, January, 1868	·058 part	..	·011 part
West Middlesex ,, ,, ,,	·027 ,,	..	·012 ,,
Southwark ,, ,, ,,	·061 ,,	..	·024 ,,
Grand Junction ,, ,, ,,	·031 ,,	..	·006 ,,
Lambeth ,, ,, ,,	·062 ,,	..	·030 ,,
Artesian well water, October, 1874	·033 ,,	..	·003 ,, ·004 ,,
,, ,, April, 1876.	·032 ,,	..	·003 ,,
Sea water, Sample No. 1	·217 ,,	..	·006 ,,
,, ,, No. 2	·134 ,,	..	·018 ,,

It is almost superfluous to say that any opinion based upon the proportion of albuminoid ammonia obtainable from a sample of potable water must almost necessarily be erroneous, like that to which the authors of the process themselves were led, when they declared the water of Bala Lake and that supplied to Manchester from the Derbyshire Hills to be more polluted than Thames water. In the course of my work upon the Rivers Commission, I have again and again met with such errors of judgment into which chemists using this process have been led. It would be preferable to depend upon chlorides and nitrates alone, rather than upon a method of estimation, the results of which do not admit of interpretation.

The numerous experiments on this process, made by others as well as by myself, have led me to the following conclusions:—

1. That the albuminoid ammonia process affords no evidence whatever of the absolute quantity, either of organic matter or of organic nitrogen, present in potable water.
2. That it does not indicate, even approximately, the relative quantities, either of organic matter or of organic nitrogen, in different samples of such water.
3. That it affords no indication either of the presence or of the proportion of albuminoid, as distinguished from other nitrogenous organic compounds.
4. That it is, therefore, entirely useless in the examination of waters for sanitary purposes.

In conclusion, I claim for the combustion process, after nearly nine years experience of it—

1. That it is the only method at present known which affords any trustworthy information respecting the organic matters present in potable waters.
2. That it is the only method which even professes to determine organic carbon in such waters.
3. That the determinations by it of organic carbon and nitrogen are fairly accurate, notwithstanding the very minute quantities of matter dealt with; and that the errors, even of a comparatively inexperienced analyst, are far within the limits which would affect a verdict upon the quality of the water submitted to investigation.
4. That it is the only process which discloses the proportion of nitrogen to carbon in the organic matter of waters, such information being often of prime importance in reference to the origin of the organic matter.
5. That since the modifications which have been made in the mode of evaporation, the process can now be conducted in any laboratory, and with a moderate expenditure of time and labour.

The report of the discussion on this paper will be given in our next number.

AMOUNT OF LIGHT OBTAINED FROM COAL.

[A communication to the *American Gaslight Journal.*]

I beg to point out a few important facts relating to experiments made by Mr. Lamson, at the Boston Gas-Works, Feb. 18 and 23, 1876, which I hope will convince every engineer that a much larger amount of light may be obtained from one pound of Penn coal than is generally extracted.

For the purpose of making the said facts as clear as possible, I will first introduce to your notice, a new and much more simple method for comparing one test with another, than by the formula for sperm equivalent, or any other.

I merely multiply the candle power by the yield of gas per pound of coal, and call the product—*candle feet.* This formula brings the yield and candle power together under one simple term, which can be easily understood and applied.

By this formula we can easily compare one gas with another, as, for example:—

If 1 lb. of Penn coal will yield 4·25 cubic feet of 15·75-candle gas, and 1 lb. of Despard coal will yield 4·25 cubic feet of 20-candle gas, what is the value of each in candle feet, and how much more valuable will the one coal be than the other for gas-making purposes, when everything else is equal?

Penn coal . . . . . 4·25 × 15·75 = 66·93 candle feet.
Despard coal . . . . . 4·25 × 20·00 = 85·00 „ „

$$\text{and } \frac{(85\cdot00 - 66\cdot93) \times 100}{66\cdot93} = 26\cdot99 \text{ per cent.}$$

The Penn gives 66·93-candle feet and the Despard 85; and, consequently, the Despard is worth 26·99 per cent. more than the other for gas-making purposes. Or, in other words, the Despard coal will yield 26·99 per cent. more light than the Penn.

Of course, there are other things which must be always taken into the account when comparing one gas coal with another, viz.—

Quantity and quality of the coke per ton.
Quantity of gas purified by one bushel of lime.

The Penn, in this case, yields more coke and requires less lime for purification than the other. By using Despard coal, one man can make 26·99 per cent. more gas per day than he can by using the other.

I will now give one more example on comparisons—viz.: If 1 lb. of coal, A, will yield 5 cubic feet of 13·60-candle gas, and 1 lb. of coal, B, will yield 4·25 cubic feet of 16-candle gas, what is the value of each, when everything else is equal?

Coal A . . . . . 5 × 13·60 = 68 candle feet.
Coal B . . . . . 4·25 × 16 = 68 „ „

As each of these coals yields 68 candle feet, they are equal in value for gas-making purposes.

I will now give the table of tests made by Mr. Lamson, and add two extra columns to each table, viz.—one for the candle feet, and the other for the sperm equivalent. I will also place at the bottom of each, one of the best and most important tests which he made, and gives in his interesting paper—viz., "We tried one curious experiment as follows:—Retorts were run under half inch vacuum; yield, 6·38 cubic feet to the lb. of 10·91 candles; air was, of course, drawn in."

TABLE No. 1.

Test, 2400 lbs. of Penn Coal; Twelve Clay Retorts; Charge, 200 lbs. each; Duration, Four Hours; Retort-Valves Open; One-Quarter Inch Pressure on Retorts.

Feb. 18, 1876. — Hours.	Meter.	Gas Made each Half Hour.	Test of each Half Hour's Candle Power.	Make per Pound in Cubic Feet.	Calculat'd Candle Power of Total Gas at end of each Half Hour.	Inlet Condenser. Degrees Fahr.	Outlet Condenser. Degrees Fahr.	Washer. Degrees Fahr.	Meter. Degrees Fahr.	Candle Feet.	Sperm Equivalent.
3	..	..	..	..	..	..	..	..	..	..	..
3.30	193	1930	19·60	·8	19·60	..	..	..	..	15·68	120
4	440	2470	17·07	1·83	18·17	95	66	52	65	33·25	255
4.30	654	2140	15·73	2·72	17·37	..	..	..	..	47·24	362
5	842	1880	12·26	3·50	16·23	91	69	50	66	56·80	436
5.30	1000	1580	10·79	4·17	15·37	..	..	..	..	64·09	492
6	1134	1340	6·88	4·72	14·37	92	69	50	65	67·82	520
6.30	1210	760	2·91	5·04	13·65	..	..	..	..	68·79	528
7	1234	240	1·5	5·14	13·41	76	66	54	65	68·92	529
..	..	..	..	6.38*	10·91*	..	..	..	..	69·60*	534*

* Test made with one-half inch vacuum.

The yield per table was 11,513 cubic feet per ton, or 5·14 cubic feet per pound, of 13·41 candle gas. The yield per test, with one-half inch vacuum, was 14·291 cubic feet, or 6·38 cubic feet of 10·91-candle gas.

TABLE No. 2.

Feb. 24, 1876. — Hours.	Meter.	Gas Made each Half Hour.	Test of each Half Hour's Candle Power.	Make per Pound in Cubic Feet.	Calculat'd Candle Power of Total Gas at end of each Half Hour.	Inlet Condenser. Degrees Fahr.	Outlet Condenser. Degrees Fahr.	Washer. Degrees Fahr.	Meter. Degrees Fahr.	Candle Feet.	Sperm Equivalent.
9.30	..	..	..	..	..	..	..	..	..	..	..
10	180	1800	19·60	·75	19·60	86	66	52	65	14·70	112·8
10.30	400	2200	17·95	1·66	18·69	..	..	..	..	31·02	238·2
11	600	2000	15·34	2·50	17·57	81	67	54	65	43·92	237·3
11.30	774	1740	14·06	3·23	16·78	..	..	..	..	54·19	416·2
12	935	1610	10·80	3·89	15·75	78	67	52	66	61·26	470·5
12.30	1068	1330	10·00	4·45	15·03	..	..	..	..	66·88	513·6
1	1170	1020	4·48	4·87	14·11	72	67	54	66	68·71	527·7
1.30	1227	570	2·00	5·11	13·55	..	..	..	..	69·24	531·7
..	..	..	..	6·38†	10·91†	..	..	..	..	69·60†	534·5†

† Test made with one-half inch vacuum.

The yield per table was 11,446 cubic feet per ton, or 5·11 cubic feet per pound of 13·55-candle gas.

If we examine the results given in the 11th and 12th columns of both tables, we see that the value of the gas in candle feet, and sperm equivalents, has gradually increased as the volume increased, and as the candle power decreased. For instance, when the production from 1 lb. of coal was only 8-10ths of a cubic foot of 19·60-candle gas, we only obtain 15·68 candle feet, and 120 sperm equivalents; but when the production was increased to 5·14 cubic feet of 13·41-candle gas, we then obtain 68·92 candle feet and 529 sperm equivalents.

A very simple calculation will now show you that the 6·38 cubic feet of 10·91-candle gas per lb. gave—

$\frac{(69\cdot60 - 15\cdot68) \times 100}{15\cdot68}$ = { 343 per cent. more light than that of the first test in table.

$\frac{(69\cdot60 - 33\cdot25) \times 100}{33\cdot25}$ = 109 per cent. more light than that of the second test.

$\frac{(69\cdot60 - 47\cdot24) \times 100}{47\cdot24}$ = 47 per cent. more light than that of the third test.

$\frac{(69\cdot60 - 56\cdot80) \times 100}{56\cdot80}$ = 22·5 per cent. more light than that of the fourth test.

$\frac{(69\cdot60 - 64\cdot09) \times 100}{64\cdot09}$ = 8·5 per cent. more light than that of the fifth test.

$\frac{(69\cdot60 - 67\cdot82) \times 100}{67\cdot82}$ = 2·6 per cent. more light than that of the sixth test.

$\frac{(69\cdot60 - 68\cdot79) \times 100}{68\cdot79}$ = 1·1 per cent. more light than that of the seventh test.

$\frac{(69\cdot60 - 68\cdot92) \times 100}{68\cdot92}$ = 0·98 per cent. more light than that of the eighth test.

These experiments and results prove conclusively that the gas fraternity have been labouring under a mistaken notion in supposing that the value of the gas decreased as the volume of the gas was increased. Instead of that being the case, by the ordinary process, the value is actually increased as the volume is increased.

I calculate that if our present process for making gas were perfect, the said tests should have given about the following results in candle power:—

First half hour . . $\frac{69}{\cdot8}$ = 86·25 candles.

Second half hour . $\frac{69}{1\cdot83}$ = 37·70 candles.

Third half hour . . $\frac{69}{2\cdot72}$ = 25·36 candles.

Fourth half hour . $\frac{69}{3\cdot50}$ = 19·70 candles.

Fifth half hour . . $\frac{69}{4\cdot17}$ = 16·54 candles.

Sixth half hour . . $\frac{69}{4\cdot72}$ = 14·61 candles.

Seventh half hour . $\frac{69}{5\cdot04}$ = 13·69 candles.

Eighth half hour . $\frac{69}{5\cdot14}$ = 13·42 candles.

Extra test . . . . $\frac{69}{6\cdot38}$ = 10·81 candles.

The constant 69, used in the dividend of this table, was about the maximum candle feet obtained from the Penn coal, and the divisors are the number of cubic feet of gas obtained in each test.

From the time the charge is placed in the retort to the time it is carbonized, the gas gradually gets lighter, and, consequently, it is brought to that condition at which it will take up a large amount of the hydrocarbons which are left in the apparatus and pipes by the heavier gas. This may possibly be one of the reasons why the value of the gas is increased as the volume is increased, as in the preceding tests.

I now think that the following facts ought to satisfy all that the results obtained in the eighth test of the table were much better than those obtained in the first test. The former gave 6·4 times the volume of gas obtained in the latter, consequently we have 6·4 times 13·41 candles, or 85 candles.

The gas as per yield in the eighth test will supply 6·4 Argand burners, each consuming 5 cubic feet per hour, and giving 13·41 candles. The candle power of the six Argand burners combined will be 6·4 × 13·41, or 85 candles, while the gas as per yield in the first test will only supply one Argand burner consuming 5 cubic feet per hour, and giving 19·60 candles.

During the year 1868, when I was working for the Manhattan Gaslight Company of this city, I introduced two methods for taking the candle power of rich gases—viz., one by gas mixtures, and the other founded on the fact that the intensity of a flame from ordinary gas is as the square of the volume of gas consumed; and in the year 1870 I introduced the gas and air, and hydrocarbon formulas for the same purpose.

As I have now a favourable opportunity for applying the formula for gas mixtures, on the tests made by Mr. Lamson, I will apply it on those in his first table.

He has fortunately given us eight series of yields, with the candle power of each, and he has also given us the sum of these yields and its candle power.

These yields varied greatly in volume and candle power. The yields per half hour ranged from 240 to 2470 cubic feet of gas, and the sum of these yields was 12,340 cubic feet.

The candle power ranged from 1·50 to 19·60 candles, and the illuminating power of the whole yield was 13·41 candles.

Now, if we multiply each of these yields by the candle power which it gave, and divide the sum of those products by the sum of the yields, the quotients will give the candle power of the whole yield as follows:—

Test.	Cubic Feet.		Candles.		Product.
1	1930	×	19·60	=	37,828·0
2	2470	×	17·07	=	42,162·9
3	2140	×	15·73	=	33,662·2
4	1880	×	12·26	=	23,048·8
5	1580	×	10·79	=	17,048·2
6	1340	×	6·88	=	9,219·2
7	760	×	2·91	=	2,211·6
8	240	×	1·50	=	360·0
	12,340				165,540·9

$$\text{And } \frac{165,540\cdot9}{12,340} = 13\cdot41 \text{ candles.}$$

Here we had eight different quantities and qualities of gas to mix and bring together.

I will now give the candle power of the whole mixture, in accordance with one of the preceding tables:—

Test.	Cubic Feet.		Candles.		Product.
1	1,930	×	86·25	=	166,462·50
2	4,460	×	37·70	=	165,880·00
3	6,540	×	25·36	=	166,854·44
4	8,420	×	19·70	=	165,874·00
5	10,000	×	16·54	=	165,400·00
6	11,340	×	14·61	=	165,677·40
7	12,100	×	13·69	=	165,649·00
8	12,340	×	13·42	=	165,602·00
	67,070				1,327,399·34

$$\text{And } \frac{1,327,399\cdot34}{67,070} = 19\cdot79 \text{ candles.}$$

The second column of this table is taken from the first column of Mr. Lamson's first table, and the second column from one of mine.

This last calculation shows that the whole yield of 12,340 cubic feet should have given 19·79 candles if the present process had been perfect—or

11,513 cubic feet of 19·79-candle gas per ton, or
5·14 cubic feet of 19·79-candle gas per lb., or
$5\cdot14 \times 19\cdot79 = 101$ candle feet.

Consequently, this calculation shows that one ton can produce by proper management 101 candle feet, or 5·14 cubic feet of 19·79-candle gas.

If the decimals had been carried out farther in this and the other table, we should have had all the products alike.

I have now come to the conclusion that Mr. Lamson has calculated the candle power (in his sixth column) of total gas at the end of each half hour, by this formula for mixtures; and, consequently, it is not quite so satisfactory as if he had tested the same on the photometer bar.

We ought not to be very much surprised at these results, for Dr. Gesnor states in his work on "Coal and Petroleum," that one ton of Pittsburgh coal will produce 49 gallons of crude oil, and also a considerable quantity of rich gas—Newcastle coal, 48 gallons; Newburgh, 72 gallons; Darlington, 56 gallons; Boghead, 120 gallons; Albertite, 110 gallons; Breckenridge, 130 gallons.

Now, as it is generally agreed that 1 gallon of crude oil will produce 70 cubic feet of 70-candle gas, we certainly ought to get better results than we generally do.

It is very singular, that with the ordinary process for making gas from coal, we never obtain any rich gas, whether the yields be large or small. We never see any signs of such rich gas as that given in the preceding calculations—consequently I am certain that the present system is radically wrong.

I calculate that Mr. Lamson lost, in his first series of tests, the following amount of gas:—

1.—$0\cdot8 - \frac{69}{19\cdot60} = 2\cdot7$ { cubic feet per lb. of 19·60-candle gas during the first half hour.

2.—$1\cdot83 - \frac{69}{18\cdot07} = 1\cdot99$ { cubic feet per lb. of 18·07-candle gas during the second half hour.

3.—$2\cdot72 - \frac{69}{17\cdot37} = 1\cdot25$ { cubic feet per lb. of 17·37-candle gas during the third half hour.

4.—$3\cdot50 - \frac{69}{16\cdot23} = 0\cdot75$ { cubic feet per lb. of 16·23-candle gas during the fourth half hour.

5.—$4\cdot17 - \frac{69}{15\cdot37} = 0\cdot31$ { cubic feet per lb. of 15·37-candle gas during the fifth half hour.

6.—$4\cdot72 - \frac{69}{14\cdot37} = 0\cdot08$ { cubic feet per lb. of 14·37-candle gas during the sixth half hour.

7.—$5\cdot04 - \frac{69}{13\cdot65} = 0\cdot01$ { cubic feet per lb. of 13·65-candle gas during the seventh half hour.

This loss, I am confident, arises from the present system of charging the retorts.

Into a small retort, 20 inches by 12 inches by 8 feet 6 inches long, we often put 260 lbs. of coal; consequently, the temperature runs down; the heat cannot penetrate the interior of the mass, and the production is only a vapour which is converted into a tarry oil by condensation.

For comparison, we will now convert the results from the coal oil into candle feet: and, as I said before, 1 ton of Pittsburgh coal will produce 49 gallons (U. S. gallon, 231 cubic inches) of crude oil, and 1 gallon of the crude oil will yield 70 cubic feet of 70 candle gas.

Consequently, 2240 lbs. of the said coal will produce $49 \times 70 = 3430$ cubic feet of 70-candle gas

or, $\frac{3430}{2240} = 1\cdot5$ cubic feet of 70-candle gas per lb. of the said coal.

Therefore, by the coal oil process, we obtain—

$$1\cdot5 \times 70 = 105 \text{ candle feet.}$$

And, by the ordinary process, we obtain—

$$5\cdot14 \times 13\cdot41 = 68\cdot92 \text{ candle feet.}$$

$$\text{And } \frac{(105\cdot00 - 68\cdot92) \times 100}{68\cdot92} = 52 \text{ per cent.}$$

Consequently, the results obtained by the coal oil process, from 1 ton of coal, are 52 per cent. higher than those obtained by the ordinary process for making gas.

By referring to a former statement in this paper, you will see that I calculated that a ton of the Penn coal would, by proper management, produce 5·14 cubic feet of 19·79-candle gas or 101 *candle feet*, and as this result is only about 4 per cent. less than that obtained by the coal oil process, I think that the said statement is not very far from the truth.

111, *Broadway, New York.* WILLIAM FARMER.

HULL GAS SUPPLY.—Mr. James Baynes reports that an examination of the gas supplied to the district of Sculcoates and Myton during June by the British Gas Company gave the following results, the gas being constantly free from sulphuretted hydrogen and free ammonia:—

	Max.	Min.	Mean.
Illuminating power standard sperm candles	16·30	14·27	15·57
Grains of sulphur per 100 feet	32·00	25·60	28·60

Mean barometer and temperature in experiment-room:—Bar., 30·00; tem., 62°.

In the east district, Mr. James Baynes, jun., reports that the gas supplied by the Sutton, Southcoates, and Drypool Gas Company was free from sulphuretted hydrogen. Results as follow:—

	Max.	Min.	Mean.
Illuminating power standard sperm candles	16·43	14·95	15·89
Grains of sulphur per 100 feet	—	—	6·35

Mean barometer and temperature in experiment-room:—Bar., 29·96; tem., 65·66°.

FURTHER RESEARCHES UPON PYROGENOUS* CARBURETS, AND UPON THE COMPOSITION OF ILLUMINATING GAS.

By M. BETHELOT.

[From the *Comptes Rendus de l'Académie des Sciences*, April 17, 1876.]

Illuminating gas possesses an altogether special advantage for the study of pyrogenous carburets, inasmuch as it contains the products of the several reactions that may take place between these bodies at a cherry-red temperature. The theory of pyrogenous bodies shows that almost all the carburets of hydrogen are generated at this temperature, from the moment when acetylene and hydrogen are found together; all these carburets being, according to my experience, allied by regular laws of transformation, and by such relations of equilibrium that the existence of any one of them at a cherry-red temperature brings about as a consequence the successive formation of all the others. A close study of illuminating gas furnishes additional proofs in support of this theory, and I am about to bring forward some facts which tend to establish in this gas the presence of benzene ($C_{12}H_6$), propylene (C_6H_6), allylene (C_6H_4), crotonylene (C_8H_6), and terene ($C_{10}H_8$), and to furnish a few ideas upon their relative proportions.

Benzene.—The presence of benzene in illuminating gas is a necessary consequence of the existence of this carburet in the products of distillation (Faraday, Mansfield), and of its tension of vapour (60 millimètres at 15° C. according to M. Regnault). However much this tension may be diminished by the presence of tarry matters, we know that the benzene may be easily demonstrated by passing the gas through fuming nitric acid, which changes the benzene into nitrobenzene. Two to three cubic centimètres (0·12 to 0·18 cubic inch) of gas and a drop of acid, which is afterwards diluted, suffice for the recognition of its characteristic odour. By slowly passing 50 litres (1·76 cubic feet) of gas through from 8 to 10 cubic centimètres (0·48 to 0·60 cubic inch) of acid, and then precipitating by water the nitrobenzene, which is weighed, the quantity of benzene may be approximatively estimated. In this way I have found, in several trials, from two to three volumes of vapour of benzine in 100 volumes of Paris gas—numbers which are a little weak in consequence of the difficulty of condensing the fumes escaping from the acid. (It is likewise necessary, in these experiments, to take into account the solubility of the nitrobenzene in the acid water.) The nitrobenezne thus obtained contains a little toluene and some accessory products; but this process of analysis is somewhat slow of execution.

The following is a more rapid process, and allows from 15 to 20 cubic centimètres (0·9 to 1·22 cubic inch) of gas to be operated upon. A flask of a capacity of from 15 to 20 cubic centimètres, and having a large opening, furnished with a stopper, is taken, and its capacity gauged. To this end it is filled with water, which is displaced by a current of air, the flask reversed being kept quite vertical; this done, a very small tube, closed at one end, and having a capacity equal to from 1·0 to 1·5 cubic centimètre (0·06 to 0·09 of a cubic inch) is taken and filled with water, then introduced into the flask, raising the small tube by the aid of the cork, which is afterwards adjusted. The cork is immediately drawn out, and the air made to pass from the flask into a graduated tube, divided into tenths of a cubic centimètre. This operation is repeated five or six times; the partial results should agree to the 10th and the average to the 20th of a cubic centimètre. In this manner the capacity of the flask, under the conditions of future analysis, is obtained. To carry this out, the small flask is filled with illuminating gas (previously freed from carbonic acid); into it is introduced the small tube, this time filled with fuming nitric acid, and the cork immediately fixed. The flask is then shaken, which changes the vapour of the benzene into nitrobenzene. After a moment's interval the cork is quickly removed—an operation which should be effected with great dexterity, seeing that the tension of the fuming acid increases the volume of the gas in a proportion often superior to the quantity of the benzene vapour absorbed. It is to compensate for this augmentation that a rather large cork was chosen; but it must be pressed down tolerably quickly, in order that the gases may not have time to escape between the neck and the surface of the cork. With this exception, the operation is easy. This done, a fragment of potash is introduced to absorb the nitric vapour, and then the residue is measured. The diminution in volume represents the vapour of benzine (and of toluene), the only gas absorbable under these conditions, in notable proportions, according to my experiments. In fact, acetylene and olefiant gas are again found after the analysis, provided that their proportion does not exceed a few hundredths. For benzene vapour, I have found numbers comprised between 3 and 3·5 hundredths in volume. I must, however, say that this number includes some trace of another carburet, as a small quantity of carbonic acid is formed in the reaction of the nitric acid; but that is an accessory phenomenon, and may be disregarded under the conditions described.

By way of test, I examined the action of sulphuric acid and bromine on the gas used in the preceding experiments. The bromine absorbed 3·7 hundredths of the primitive gas—a figure scarcely higher than that of the benzene vapour. Boiled sulphuric acid absorbed by an immediate action 1·8 hundredths; but from this figure must be deducted the vapour of water, the tension of which represented 1·6 under the conditions of the experiments. There remain then 0·2 hundredths at the most for the carburets, whatever they may be, absorbable by boiled sulphuric acid (propylene, allylene, crotonylene, &c.), which is a figure so small, that it cannot be taken into consideration. Bromine, acting afterwards upon the residue of this reaction, absorbed 3·5 hundredths—a figure scarcely different from the volume absorbable by nitric acid.

It follows from these experiments that the carburets which are not immediately absorbable, either by fuming nitric acid, or by boiled sulphuric acid, though absorbable by bromine—that is to say, acetylene, ethylene, &c.—exist but in a very small proportion, two to three thousandths at the most. This result agrees with experiments made long since, by which I directly extracted, and then regenerated, ethylene (in the form of ioduret, in 1854) and acetylene (in the form of cuprous acetyide) from illuminating gas.

To sum up, benzene constitutes the most abundant carburet, next to formene in the Paris gas. It is found in the proportion of about 3 per cent. in volume, or 100 grammes per cubic mètre (35·3 cubic feet). In such a gas, benzene represents the lighting carburet *par excellence*, although this gas, when deprived of benzene vapour, still retains a sensible illuminating power, doubtless owing to the presence of a small quantity of the saturated carburets of the formenic series (C_2nH_{2n+2}), more condensed than formene itself.

The eudiometric analyses effected by combustion—the only ones, until recently, employed in the study of illuminating gas—furnish only imperfect indications. The translation of their results by the names of determinate carburets, ethylene, butylene, &c., which would be met with in the proportion of 4, 6, or 8 hundredths, is absolutely erroneous, resting, as it does, only upon a simple working of algebraic equations, calculated on the hypothesis of certain unknown quantities, which do not conform to reality.

Ethylene, acetylene.—The existence and the approximative proportion of ethylene and acetylene being indicated by the proofs brought forward above, I pass to the other hydrocarbon gases.

Propylene, butylene, allylene, &c.—I have sought to characterize these gases by uniting them with sulphuric acid, in order to change them afterwards into hydrates. To this end I cause the lighting gas (drawn in by the aid of a trumpet-tube) first of all to pass through sulphuric acid, which has been diluted by water, and then through a column of pumice-stone

* Fire or heat begotten.

strongly soaked with concentrated sulphuric acid. At the end of sufficient time I examined the products. In the first flask (diluted acid), a tarry matter had condensed—4 to 5 grammes per 100 cubic mètres (3530 cubic feet)—which did not furnish volatile products until it had been heated to from 360° to 400° C. I did not pursue the study of this product, but I think it was derived from the polymeric condensation of some very alterable carburet, such as diacetylene or analogous bodies. The aqueous acid itself, submitted to a suitable system of fractional distillations, finally furnished a little acetone—about 0·25 gramme per 100 cubic mètres. I regard this body as signalizing the existence of allylene ($C_6 H_4$), of which it represents one of the hydrates. But a portion of this carburet was changed into triallylene (mesitylene) under the influence of the acid; this portion will be valued further on at 1·25 gramme per 100 cubic mètres.

In the second flask, or, more strictly, in the column containing the pumice-stone, the sulphuric acid flowed away, little by little, towards the lower part, which was purposely left free. Two layers of liquid were found—a mixture of hydrocarburets, which floated on the top, and sulphuric acid more or less changed, charged with the water removed from the gas, and giving out a strong odour of sulphurous acid. This lower layer, isolated and diluted by water, precipitates a hydrocarbonated substance, viscous, and volatile only above 300° to 400° C. I have not succeeded in obtaining any definite body from it; but there is no doubt that it represents polymerized products (25 grammes per 100 cubic mètres). The acid having been diluted with water and distilled several times over, I at last obtained isopropylic alcohol, mixed with some few of the analogous hydrates (altogether 0·5 gramme per 100 cubic mètres of gas. This composition marks the existence of propylene, and furnishes some index of its proportion, although a portion of it had been polymerized.

I shall now bring forward the results furnished by an examination of the hydrocarburets insoluble in sulphuric acid.

I have explained how lighting gas directed through a column of pumice-stone soaked in concentrated sulphuric acid furnishes a liquid which separates into two layers, one formed by the more or less changed sulphuric acid, the other by a mixture of hydrocarburets. It is with this mixture that I am now about to occupy myself. It rose to 25 grammes per 100 cubic mètres of gas. Submitted to three methodical series of fractional distillation, it was resolved into—

Benzene mixed with a little toluene	2
Mesitylene (approaching 160° to 170° C.), $C_{18} H_{12}$	5
Cymene (approaching 180° C.), $C_{20} H_{14}$	20
Tricrotonylene (220° to 240° C.) $C_{24} H_{18}$	30
Colophene (300° to 320° C.) $C_{30} H_{24}$	32
Residue fixed at 320° C.	5
Intermediate products and loss	6
Total	100

Benzene.—Benzene has been recognized by its classic reactions. It derives its origin from the pre-existing vapour, of which a faint portion remains dissolved in the condensed liquids. The smallness of this portion, relatively to the total mass of the benzene in vapour, is explained by the fact that lighting gas, even after the reaction of sulphuric acid, is not saturated with this vapour, which then possesses scarcely two-fifths of its maximum tension. This observation, applicable *à fortiori* to the other vapours of the pre-existing carburets, the relative quantity of which in the gas is very much less than that of benzine, shows that their liquefaction on coming in contact with acid can only give rise to inconsiderable proportions of matter. The following carburets, therefore, are not pre-existent in gas, but result from more volatile carburets transformed by sulphuric acid.

Mesitylene ($C_{18} H_{12}$) gave on analysis—

Found.		Theory.	
C.	89·7	C.	90·0
H.	10·3	H.	10·0

It boiled at nearly 165° C., and offered the known properties and reactions of the mesitylene from acetone. I attribute the origin of this carburet to the condensation of the allylene ($3 C_6 H_4 = C_{18} H_{12}$) under the influence of sulphuric acid; 100 cubic mètres of gas furnished 1·25 gramme of it, which, added to the allylene, changed into acetone, would make 8 millionths in volume of allylene (at the minimum) in lighting gas.

Cymene ($C_{20} H_{14}$) gave on analysis—

Found.		Theory.	
C.	89·3	C.	89·5
H.	10·7	H.	10·5

It boiled at nearly 180° C. The properties and general reactions of this body were the same as for the cymene from camphor. I regard the preceding cymene as formed by the action of sulphuric acid upon a terebene (Riban), $C_{20} H_{16}$, which would be itself derived from the condensation of a carburet $C_{10} H_8$: $2 C_{10} H_8 = C_{20} H_{16}$, a much more volatile carburet, contained in lighting gas; it is *terene*, or *propylacetylene*, $C_6 H_5$, $C_4 H_3$, a homologue of allylene (methylacetylene) and of crotonylene (ethylacetylene). I shall return to this subject.

Tricrotonylene ($C_{24} H_{18}$) gave on analysis—

Found.		Theory.	
C.	88·8	C.	88·9
H.	11·2	H.	11·1

This carburet boils at about 230° C. It is dissolved by fuming nitric acid in the same manner as benzinic carburets, of which it possesses the general reactions. This body comes from the same source as triethylbenzine, with respect to which it bears the same relations as triallylene bears to trimethylbenzine. The tricrotonylene differs from acenaphthene (formed equally by the successive union of six ethylenic residues) only by the hydrogen, and I think that it will be found again in coal tar. The tricrotonylene obtained in the preceding operation appears to me to be derived from crotonylene ($C_8 H_6$) contained in the gas and polymerized by sulphuric acid: $3 C_8 H_6 = C_{24} H_{18}$; 100 cubic mètres of gas furnished 7·5 grammes of it, being 31 millionths in volume of gaseous crotonylene at the minimum.

Colophene or *Triterene* ($C_{30} H_{24}$) gave on analysis—

Found.		Theory.	
C.	88·4	C.	88·2
H.	11·3	H.	11·8

It distilled at nearly 300° C. Its physical properties and its reactions were those of ordinary colophene,* and, like the latter, its analysis shows rather weak numbers for hydrogen, doubtless in consequence of the mixture of a less hydrogenated carburet, such as a terecymene ($C_{30} H_{22}$ or $C_{10} H_8$, $C_{20} H_{14}$); but I do not insist upon this point.

Colophene doubtless results from the polymerization by sulphuric acid of the terene indicated above: $3 C_{10} H_8 = C_{30} H_{24}$; 100 cubic mètres of gas furnished 13 grammes of cymene and colophene united, which would represent a nearly equal weight of the primitive terene; that is, 42 millionths in volume of gaseous terene (without prejudice to the more condensed polymers, which it was impossible to quantitatively analyze).

According to these results, the portion absorbable by bromine, which constitutes the greatest fraction of the lighting portion of Paris gas, would be composed nearly in the following manner, for one million volumes of the specimen upon which I operated:—

Benzene in vapour ($C_{12} H_6$)	30,000 to 35,000
Acetylene ($C_4 H_2$)	1,000 about.
Ethylene ($C_4 H_4$)	1,000 to 2,000
Propylene ($C_6 H_6$)	2·5
Allylene ($C_6 H_4$)	8·0
Butylene ($C_8 H_8$) and analogous matters	Traces.
Crotonylene ($C_8 H_6$)	31·0
Terene ($C_{10} H_8$)	42·0
Carburets identical with, or unlike, the preceding, but transformed into almost fixed polymeres estimated (according to the weight of the polymeres) at	83·0
Diacetylene and analogous carburets, similarly estimated at	15·0
	181·5*

These products may be regarded as produced in part by dry distillation, and in part derived one from the other and from formene, following the regular reactions which I observed in the study of the pyrogenous carburets. In fact, I pointed out the reciprocal and direct metamorphoses of the four fundamental hydrides of carbon—acetylene $C_2 H$ (2 V), ethylene $C_2 H_2$ (2 V), methyl $C_2 H_3$ (2 V), and formene $C_2 H_4$ (4 V)—which constitute with hydrogen a system in equilibrium, by which the four fundamental carburets are formed at the cherry-red temperature at the cost of the particular one among them taken as the starting-point. This is a fact ascertained by experiment.

I have also shown, by experiment, how *free* formene (marsh gas) directly engenders not only ethylene $(C_2 H_2)_2$, but propylene $(C_2 H_2)_3$, also, and probably the entire series of polymeric carburets $(C_2 H_2)n$.

Free acetylene likewise engenders, by direct synthesis, benzene, $C_{12} H_6 = (C_4 H_2)_3$, and an entire series of polymers $(C_4 H_2)n$, among which benzene predominates, on account of its greater stability.

All these bodies are, in fact, met with again in lighting gas, and in coal tar simultaneously formed.

Not only are the four fundamental carburets ($C_2 H$, $C_2 H_2$, $C_2 H_3$, $C_2 H_4$) and the polymers of the two first $(C_2 H)_2$ $(C_2 H_2)n$, thus brought into existence, but all these bodies combine two by two, always under the influence of the cherry-red temperature, to constitute more complicated carburets, in equilibrium with the more simple ones by which they are engendered. It is in this way that I effected with acetylene and benzene the immediate synthesis of styrolene ($C_{16} H_8$), with acetylene and styrolene the synthesis of naphthaline ($C_{20} H_8$), with acetylene and naphthaline the synthesis of acenapthene ($C_{24} H_{10}$), and with styrolene and benzene the synthesis of anthracene ($C_{24} H_{10}$), all carburets which are met with again in coal tar. In the same way I found that acetylene and ethylene combine in equal volumes, at about a dull red temperature,

$$C_4 H_2 + C_4 H_4 = C_8 H_6$$

to constitute ethylacetylene, a carburet of which M. Prunier has established the identity with crotonylene, and which is again met with in lighting gas.

I have likewise found, in unpublished experiments, that acetylene and propylene unite directly and under the same conditions,

$$C_4 H_2 + C_6 H_6 = C_{10} H_8$$

to constitute propylacetylene, a liquid carburet, extremely volatile, and very alterable by sulphuric acid. It is also easy to show the synthesis of ethylacetylene, though the combination is a little less definite, in consequence of the simultaneous formation of a small quantity of benzene, at the cost of the acetylene. However, by operating in a curved bell-glass, a half-hour's heating suffices to combine a third of the propylene and acetylene. This propylacetylene seems to me identical with the terene of the lighting gas, and probably also with the carburet derived from caoutchouc, by means of which M. Bouchardat effected the synthesis of terpilene and of divers other terebic carburets.

These observations show what connexions exist between the formation of the divers carburets of lighting gas. In every operation of this nature, performed at the cherry-red temperature, a first analysis tends to restore the original principles to the state of the four fundamental carburets—acetylene, ethylene methyle, and formene—which forthwith re-combine to form by synthesis the entire system of pyrogenous carburets.

IRON AND COAL TRADES OF SHEFFIELD, SOUTH YORKSHIRE, AND NORTH DERBYSHIRE.

(FROM OUR OWN CORRESPONDENT.)

The north country and Staffordshire quarterly meetings of ironmasters had not been looked forward to with any particular interest by the trade hereabouts, it having been regarded as a perfectly foregone conclusion that no change in prices would be made. This result has, of course, been recorded, but it must be confessed that there never was a time when the periodical gatherings were of such slight importance. In this locality the manufacturers and vendors of iron speak of trade and trading prospects in the most despondent tones, and appear to be fully convinced that there will be no improvement for at least six months.

Some classes of pig iron have been selling fairly well during the week, the existing low prices having tempted some of the large concerns to purchase extensively for stock. This has been especially observable in respect of some of the hematite brands, which have, in consequence, been sent up in price to the extent of about 2s. 6d. per ton.

At the merchant iron works in this district a deplorable state of affairs prevails. I cannot, for very obvious reasons, mention names, but I may say that at one large establishment every department but one is idle; at another the machinery is going one day and idle the next—just as the current postal deliveries furnish or do not furnish the means of going on; at others, next to nothing is being done. Iron, it is freely alleged, cannot be sold at a profit, so that many of the producers are not pushing, but are simply "sliding along."

Fuel is in plethoric supply. The coalowners have three times the quantity they can dispose of and the merchants who manage to get rid of some portion of their consignments aver that they have the greatest possible difficulty to secure payments. It is consequently no matter of suprise that many failures are taking place, and that others are daily expected.

THE LANCASHIRE COAL AND IRON TRADES.

(FROM OUR OWN CORRESPONDENT.)

There appears to be a considerable amount of dissatisfaction amongst colliery proprietors with regard to the manner in which gas coal tenders have been dealt with this season by many of the gas companies. I announced in a previous report that several of the companies were postponing their decisions, and these have now, in some quarters, been delayed for such a length of time that some of the tenders have been withdrawn, and, although there is still a considerable amount of gas coal in the market which has not been placed, many of the colliery proprietors are preferring to take their chance of the market rather than compete

* I admit for colophene, volatile at about 300° C., the formula $C_{30} H_{24}$, instead of $C_{10} H_{32}$. I have been led to this opinion by an examination of the reaction of iodhydric acid (*Bull. de la Soc. chim.*, 2nd series, vol. xi., p. 26, 1869), and by the density of vapour of copahuvene (p. 31). M. Riban has even found recently the figure 8·3 for the density of vapour of colophene, which is not far removed from 7·14, the figure required by theory.

* These figures are a minimum, an unknown proportion of the several carburets having traversed the sulphuric acid without becoming modified by it.

any further for contracts at the low prices which consumers appear disposed to give. A few contracts are reported to have been placed in the Manchester district at fair prices, but the great proportion of the sales have been at very low rates, the cases being exceptional where more than 9s. 6d. per ton for good screened Wigan gas coal at the pit has been obtained.

The demand for other descriptions of fuel continues very limited, with supplies abundant, and where the pits are running full time, stocks are accumulating. Although no material change has been made in quotations, slight concessions are offered in competing for good orders, and late rates are difficult to maintain. The average pit quotations in the Wigan district may be given as under:—Best Arley Mine, 11s. to 11s. 6d.; common ditto, 9s. to 9s. 6d.; Pemberton four-feet, 9s. to 9s. 6d.; common coal, 7s. to 7s. 6d.; burgy, 5s. 6d. to 6s.; and slack, 3s. 6d. to 4s. 6d. per ton. . . . . .

For coke there is still very little inquiry, and a very large proportion of the ovens in this district have now been put out in consequence of the absence of orders, makers as a rule only producing just what they can find a market for. Nominally prices are without much change, best cokes delivered into the Manchester district being quoted at about 20s. per ton.

As I anticipated in my last report, the wages dispute in South Lancashire has only been of short duration, the men, after a stoppage of two or three days, agreeing to accept the 15 per cent. reduction, and operations have now been resumed at the pits.

In the iron trade there is very little change to notice, the demand continuing very dull and prices weak. Makers of the commoner brands of finished iron appear in some cases disposed to accept a trifle less money, but the best brands are without change. Very much the same remarks apply to pig iron, the better qualities being tolerably steady, whilst in the lower numbers there is underselling to secure orders.

THE COAL AND GENERAL TRADE OF THE NORTH OF ENGLAND.

(FROM OUR OWN CORRESPONDENT.)

The coal trade of the Tyne and Wear improves a little in tone. The best collieries in the steam and gas trades maintain their prices very steadily, and several of the best gas firms have pretty considerable contracts running, so that they have not many coals to place in the open market. Inferior gas coals, as reported in this column from time to time, are very irregular in their quotations. In fact, a quoted price can hardly be given, as the principal business done in the trade is a matter of bargain. It is stated that a considerable contract was made in London last week for second qualities of gas coals at 6s. 9d. per ton. The shipment of gas coals from the Tyne Dock continues active. As there is no local demand for manufacturing purposes, these coals are pressed upon the market for shipment, and it is quite possible that a good deal that is sent to the Continent is upon consignment. The most active trade doing at present is in steam coals. The steam collieries are now working to full time, and there is every prospect that they will do so until the end of September. There is no improvement in the manufacturing coal trade. The local demand is wretchedly poor.

The freight market does not change very much. Coasting business is quiet at about 4s. 6d. per ton to London for steamers, and 5s. 9d. per ton for small sailing vessels to discharge at the wharves; 7s. per ton is paid to sailing vessels to Southampton, and 5s. to Lowestoft. These represent the principal coasting quotations; but coal merchants are very slow in putting orders into the market. Baltic outward rates are steady, both for sailing and steam vessels There is a very fair inquiry for the Italian ports, but outward business never was worse for the Levant and Black Sea. There are few goods going to the Continent just now. Continental merchants seem to be in a timid, nervous state at present, and are very much disinclined to enter upon fresh transactions

The Cleveland iron trade shows no change. Pig iron is shipped in considerable quantities to the Continent and Scotland. The manufacturing iron trade, however, keeps poor, the principal demand being for foundry work and foundry iron. A good few gas and water pipes are being shipped to the Continent.

The chemical and general trade of the district is no worse than it was a fortnight ago. In fact, it is better. The tone of the trade is firmer. More chemicals were sold in the market on Saturday, though it could not be said that there was any change in price.

TRADE NOTES FROM SCOTLAND.

(FROM OUR OWN CORRESPONDENT.)

The first thing that calls for notice at my hands this week is the fifteenth annual meeting of the North British Association of Gas Managers, which was held in Edinburgh last Friday, under the presidency of Mr. Samuel Stewart, engineer and manager, Corporation Gas-Works, Greenock. There was a very large attendance, embracing almost all the best known members of the gas engineering profession in Scotland. As you will be receiving an official report of the proceedings, I need not enlarge upon the president's inaugural address, and the papers read, and the discussions which took place upon them. I may make a few jottings, however, upon some of the points that will scarcely get into the formal report to be furnished for publication in the pages of the JOURNAL. Mr. D. Bruce Peebles's paper on "Governors" was a most interesting and comprehensive discussion of a subject on which he has, during recent years, done a very great deal towards inventing a perfect governor, which, by undergoing certain modifications, is adapted to almost every purpose for which governors are required in the distribution and consumption of illuminating gas. Much regret was felt and expressed at Mr. William Young, of Clippens Shale Oil Works, being almost completely shunted, on account of the limited amount of time for getting through the very attractive programme provided for the meeting by the excellent secretary, Mr. M'Kenzie. Mr. Young had a somewhat elaborate paper prepared, and numerous experiments were arranged for, in order to illustrate it. A few of the latter were performed by way of showing the intensely interesting nature of the scientific field in which he has been working during the last few years, but no attempt was made either to read the paper or to summarize its contents. The lecture on "The Chemistry of the Combustion of Coal Gas," by Dr. Stevenson Macadam, was somewhat brief, as lectures go generally, but the subject was invested with a sort of peculiar interest, owing to the novelty of some of the experiments, and the convincing facts and arguments brought forward to demonstrate that well-made and well-purified coal gas, if properly burned, exerts but an infinitesimally small deteriorating influence upon the atmosphere of an apartment in which such gas is used. Lastly, the dinner was a very enjoyable termination of a good day's work. Mr. Stewart presided, and Mr. MacPherson, of Kirkcaldy, the president-elect, performed the duties of the vice-chair. A very large party sat down to dinner, and there was some good speaking, in support of several of the toasts, and in the replies. An agreeable feature of the meeting and of the dinner proceedings was the fact of Mr. Walker, of Milwaukie, a Scotch gas manager, who has been about thirty years in the United States, delivering himself of some remarks upon the Sunday labour question in gas-works, and upon the hearty enthusiasm of the American gas managers in the support of their own Association. Stirling was fixed upon for the next annual meeting, and a very general opinion has arisen in favour of the meeting extending over two days in future, so that a larger amount of time may be secured for the more deliberate consideration of the several subjects to be brought under the notice of the members.

It is understood that this year's balance-sheet of the Paisley Gas Corporation will show a surplus revenue over expenditure of about £1500. During the past year a saving of £2500 has been effected in the cost of coal, owing to the reduced prices at which that commodity has been obtainable. I believe it is not intended, at the forthcoming annual meeting of the Gas Commissioners, to recommend a reduction in the price of gas, the present rate of which is 4s. 2d. per 1000 cubic feet; it is probable, however, that they will agree to extend and improve the existing works, at a cost of about £16,000.

It has been resolved by the Denny Gas Consumers Company to increase their capital from £1500 to £2500, by an issue of 1000 additional shares of £1 each, having a guaranteed preferential dividend at the rate of 6 per cent. per annum for five years, after which period the additional shares are to become ordinary shares. The company are of opinion that by this arrangement they will be able to relieve themselves of their present difficulties, and be placed in a position to yield satisfactory results.

The Stranraer Gas Company have resolved to reduce the price of their gas from 6s. 8d. to 6s. 3d. per 1000 cubic feet, and to pay a dividend of 5½ per cent.

A reduction from 6s. 3d. to 5s. 5d. per 1000 feet has just been made by the proprietors of the Johnstone Gaslight Company. The rate some months ago was 7s. 3d. per 1000 feet.

At the annual meeting of the shareholders of the Banff Gaslight Company, last Monday, it was resolved to reduce the price of gas from 8s. 4d. to 7s. 6d. per 1000 cubic feet.

The East Wemyss and Buckhaven Gaslight Company have just held their annual meeting, and have reduced the price of gas 10d. per 1000 cubic feet—from 8s. 4d. to 7s. 6d.

The Gas Commissioners of Broughty Ferry met a few days ago, and agreed to make a reduction in the price of gas from 5s. 10d. to 5s. per 1000 feet, with 5 per cent. discount for prompt payment, and the price to consumers outside the burgh to be reduced proportionately. The commissioners have taken contracts for the extension of their plant, at an estimated cost of about £2200. From the balance that is left over, it is thought that another reduction in price may be effected next year.

A reduction in the price of gas, from 5s. 10d. to 5s., has been made by the Gaslight Company of Kilsyth; but the profits of the past year were not sufficient to warrant a dividend being declared.

Last week's report by Dr. Wallace on the illuminating power and purity of the Glasgow gas, shows the average luminosity to have ranged from 25·86 candles at Partick station, to 29·06 candles at the Tradeston station. The maximum ranged from 26 candles (Partick) to 29·35 candles (Tradeston). The Dalmarnock gas showed 16·42 grains of sulphur per 100 cubic feet.

At the last meeting of the Town Council of Edinburgh, it was reported that, on the 6th of July, the gas supplied to the city by the Edinburgh Gas Company had an illuminating power equal to 32·90 candles, and that supplied by the Edinburgh and Leith Company 33·70 candles.

The price of pig iron became firmer about the middle of the past week, and warrants were selling at 56s. 7½d., cash, on Thursday. Iron is going into the warrant stores at the rate of 500 tons per day. There was no market on Friday, owing to the Glasgow Fair holidays.

Coal is still in very limited demand, and prices are keeping very low. There are some gas coal contracts being closed, and offers are asked in several instances.

BIRMINGHAM WATER SUPPLY.—With reference to the Birmingham water supply during June, Dr. Hill, the medical officer of health for the borough, reports that it was slightly turbid, and that the proportion of organic impurities continues high.

INSTITUTION OF CIVIL ENGINEERS.—The originality, labour, and ingenuity displayed by the authors of some of the communications submitted to this society during the past session have led the council to make the following (amongst other) awards:—Telford medals and Telford premiums to Gilbert Richard Redgrave, for "Sewage Interception Systems, or Dry Sewage Processes," and William Shelford, for "The Treatment of Sewage by Precipitation." A Telford premium to John George Gamble, B.A., for "The Brighton Intercepting and Outfall Sewers;" to George James Symons, for "The Floods in England and Wales during 1875, and Water Economy;" to Charles Greaves, for "Evaporation, and Percolation;" and to William Thomas Sugg, for "Estimating the Illuminating Power of Coal Gas." Some of the papers read at the supplemental meetings, exclusively by students of the institution, have likewise been similarly acknowledged; amongst these are a Miller scholarship to the Hon. R. C. Parsons, B.A., for "The History and Theoretical Laws of Centrifugal Pumps, as supported by Experiment, and their Application to their Design," and a Miller prize has been bestowed in the following case:—To A. E. Baldwin, for "Tunnelling in the London Clay."

Register of New Patents.

APPLICATIONS FOR LETTERS PATENT.

2691.—ANDERSON, C., Leeds, "An improved means or apparatus for connecting and disconnecting gas, water, or other pipes." June 30, 1876.

2712.—HENDERSON, A. G., Edinburgh, "Improvements in gas-meters." July 1, 1876.

2716.—OUTRIDGE, J. E., Swansea, Glamorgan, "Improvements in the construction and arrangement of steam and similar power engines, applicable also for pumps." July 1, 1876.

2718.—FOSTER, J., Winchfield, Hants, "Improvements in apparatus to be employed in connexion with water-closets, sinks, and other like communications for ventilating sewage receptacles and excluding exhalations therefrom." July 1, 1876.

2741.—JOHNSON, S. H., F.C.S., Stratford, London, "Improvements in filter-presses." July 4, 1876.

2746.—SAX, J., Bloomsbury, London, "A new apparatus or gauge for showing by electricity the depth and quantity of water in a tank, cistern, or other receptacle of water, and to give alarm if the water should be reduced below a certain depth or attain a higher level than required." July 5, 1876.

2747.—BOND, F. T., Gloucester, "Improvements in filtering and purifying water and other liquids, and in the apparatus employed therein." July 5, 1876.

2758.—LEWTAS, J., Manchester, "Improvements in apparatus for lighting, heating, and cooking purposes." July 6, 1876.

2787.—BOWKER, W., Manchester, "Improvements in screwing, tube-cutting, and nut-tapping machines." July 8, 1876.

PATENTS WHICH HAVE PASSED THE GREAT SEAL.

112.—FEREDAY, W. W., Poplar Road, London, "Improvements in treating the human excreta, and converting the same into a dry and highly concentrated manure." Jan. 11, 1876.

207.—KIDD, J. H., Wrexham, "Improvements in the process of and arrangements and machinery for treating excreta, house refuse, and sewage sludge, to obtain manure and other products therefrom." Jan. 19, 1876.

273.—JOHNSON, J. H., Lincoln's Inn Fields, London, "Improvements in apparatus for cleansing water from impurities." A communication. Jan. 24, 1876.

392.—WEYHE, W., Bremen, Germany, "Improvements in apparatus for raising or forcing fluids." Feb. 1, 1876.

1074.—SAVILLE, G. E., Sowerby Bridge, York, "An improved gas scrubber or washer." March 11, 1876.

The GRAND MEDAL of MERIT at the VIENNA EXHIBITION has been AWARDED to

GWYNNE & BEALE'S PATENT IMPROVED GAS-EXHAUSTERS,

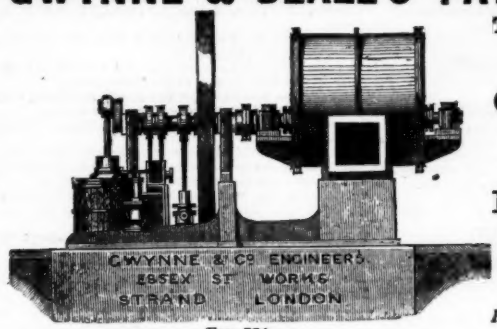


FIG. 224.

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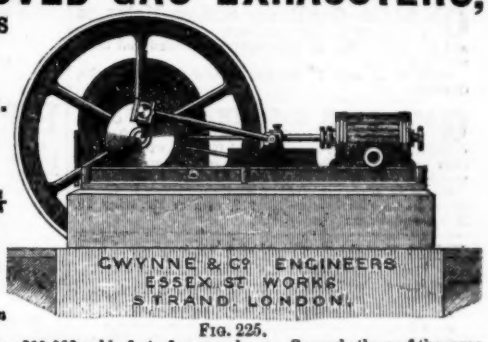

FIG. 225.

Fig. 224 represents one of those erected at the Imperial Gas-Works, Bromley, capable of passing 210,000 cubic feet of gas per hour. Several others of the same size are now on order for the same Company. These Patent Machines combine the highest quality of workmanship and materials, the largest bearings and wearing surfaces, with the **most perfect system of action yet discovered.** Fig. 225 represents one of a series of four at the Nottingham Gas-Works, each passing 52,500 cubic feet per hour. GWYNNE AND Co. *do not pretend to enter into a struggle with other makers in respect to cheapness. They have never sought to make price the chief consideration, but to produce Machinery of the very highest quality, and the most approved design and arrangement.* Their prices have been estimated with a due regard to the **excellence of the article produced,** and when this is taken into consideration, they have no fear for the result. The orders executed this season for Exhausters and alterations to their patented system amount to over 4,000,000 cubic feet of gas passed per hour, and to over 300 horse power for Engines to drive them. In every instance their work is giving the greatest satisfaction. Numerous testimonials and references can be given.

REGULATORS, BYE-PASSES, STOP-VALVES, GAS-VALVES, & MACHINERY FOR GAS MANUFACTURE, OF ALL SIZES,
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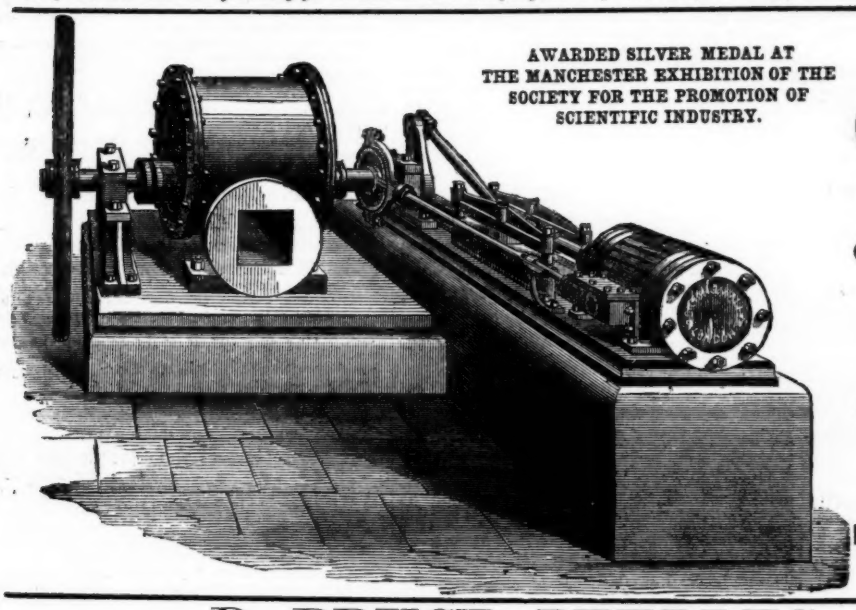
G. & Co. are now manufacturing for a London Gas Company three of their 210,000 cubic feet Patent Gas Exhausters, and many of all sizes.



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ABOVE 30,000 OF WHICH ARE NOW IN USE.

"These Lamp-Governors are so superior that they are likely to supplant all others."—*Dr. Wm. Wallace, F.R.S.E., F.C.S.*

D. BRUCE PEEBLES AND CO., FOUNTAINBRIDGE WORKS, EDINBURGH.

TO GAS COMPANIES.

WANTED a Situation, by a Working Manager, who can set clay and iron retorts, do service-laying and gas-fitting, &c. References can be given.

Address No. 281, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

WANTED, at once, for a small Gas- Work in North Wales, a WORKING MANAGER, who understands the manufacture and distribution of gas, retort-setting, main-laying, &c. Salary to commence at £50 per annum. House, gas, and coal found.

Applications, stating experience and references, to be forwarded immediately to Mr. J. T. HALL, Prescot, LANCASHIRE.

WANTED immediately, by a Gas and Water Company (incorporated by Act of Parliament) supplying a fashionable watering-place in the South of England of about 6000 inhabitants, a SECRETARY and MANAGER, thoroughly conversant with the manufacture and distribution of gas, the supply of water, and book-keeping by double entry. A clerk and collector, and efficient foreman are kept.

Applications, stating age, salary required, when disengaged, &c., with testimonials (copies only) to be forwarded to the undersigned before the 21st of July inst., marked "Vectis."

GEORGE GARNETT.

The Friars, Ryde, Isle of Wight, July 10, 1876.

ADVANTAGES OF GAS FOR

COOKING AND HEATING.

HINTS ON GAS BURNERS, &c.

By MAGNUS OHREN, A.I.C.E., F.C.S.

Specimen Copy by post Threepence, direct from MAGNUS OHREN, Gas-Works, Lower Sydenham, London, S.E.

TO TAR DISTILLERS AND MANUFACTURERS OF SULPHATE OF AMMONIA.

SITUATION as Manager Wanted, by a thoroughly practical Man. Has been engaged in a similar capacity for 12 years. Excellent testimonials. Satisfactory reasons given for leaving present employment. No objection to go abroad.

Address No. 282, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

TO GAS COMPANIES.

A Gas Manager, who will be shortly dis- engaged, desires a RE-ENGAGEMENT. Has had sound practical experience. Is thoroughly acquainted with the most modern and approved appliances introduced in the manufacture of gas. Aged 28. Satisfactory references.

Address E. YATES, Manager, Gas-Works, OAKHAM.

GASHOLDER MEN WANTED.—Apply to W. C. HOLMES AND Co., Whitestone Iron-Works, HUDDERSFIELD.

THE Advertiser (a retired Gas Engineer) requires some one who is a large consumer or purchaser of Fire-Clay Goods, to join him in purchasing and developing a FIRE-BRICK WORKS, offered him under exceptional circumstances.

The clay is of first-rate quality, and the works, having a siding from a railway, and being near a port, are well suited for a large and profitable business. Capital required £750 to £1500.

Address No. 280, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

FOR SALE—Station-Meter by Brad-dock, in perfect order, new five years ago, to pass 6000 feet per hour; 7-in. connexions. Also four PURIFIERS, 6 ft. square, hydraulic centre-valve, 7-in. connexions.

Apply to W. GUNDILL, Gas-Works, PONTEFRACT.

STATION-METER for Sale, in good condition (Makers West and Gregson), in very ornamental case, fitted up with tell-tales, inlet, outlet, and bye-pass valves, and 12-in. connexions. Passes 25,000 cubic feet per hour. Now replaced with a larger one.

For price, &c., apply to JOHN W. WHITAKER, Manager Gas-Works, WAKEFIELD.

GAS SHARES TO BE SOLD, in a country Gas Company, incorporated by Act of Parliament. Apply to W. L. RAMSDEN, 11, Fitzwilliam Street, HUDDERSFIELD.

ON SALE—One Round Station-Meter, to pass 12,000 feet per hour, with 8-in hydraulic valves and bye-pass. Will be thoroughly overhauled and fitted with new drum.

Apply to J. AND J. BRADDOCK, Globe Meter-Works, OLDHAM.

GASHOLDER COLUMNS FOR SALE, cheap and good, twelve in number, about 30 ft. high, diameter near base 2 ft., near cap 1 ft. 6 in., with moulded caps and bases, guide-rails, and brackets complete, and suitable for a gasholder about 90 ft. diameter by 30 ft. deep.

Offers for same, delivered at a railway station in Lancashire, to be addressed to No. 279, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

THE Swansea Gaslight Company have for immediate SALE, the following Plant:—

A 6-h.p. Patent Trunk Engine. (Beale.)
Cylindrical Egg-ended Boiler, 20 ft. by 4 ft. 6 in. (Beale.)
Exhauster to pass 15,000 feet per hour. (Beale.)
An 8-h.p. Grasshopper Engine. (Easton and Amos.)
Cylindrical Egg-ended Boiler, 20 ft. by 4 ft. 6 in. (Easton and Amos.)
Exhauster, 20,000 ft. per hour. (Beale.)
Tar, Liquor, and Water Pumps, Eccentrics, Shafting, and Driving Pulleys.
Wrought-iron Condenser, six vertical Legs, 30 ft. high, 24 in. by 6 in., with tar-boxes, dips, and syphons.
Wrought-iron Scrubber, 5 ft. diameter, 20 ft. high.
Cast-iron Scrubber, 3 ft. diameter, 20 ft. high.
A set of four cast-iron Purifiers, 12 ft. square by 5 ft. deep, with galvanized wrought-iron covers, lifting apparatus, four tiers of wooden sieves, 10-in. connexions and valves.

May be seen at the Gas-Works, Swansea. The whole in perfect working order; replaced by plant of larger dimensions.

Further particulars may be obtained on application to Mr. THORNTON ANDREWS, SWANSEA.

TO MAIN LAYERS.

THE Directors of the Town and County of Poole Gas and Coke Company, Limited, are prepared to receive TENDERS for laying about 850 yards of 10-in., and about 300 yards of 6-in. MAINS.

Plan and specification may be seen at the Company's Office.

Tenders to be delivered at the Company's Office on or before Monday, the 24th inst.

The Directors do not pledge themselves to accept the lowest or any tender.

By order,
JOHN BUDDEN, Secretary.

Gas-Works, July 11, 1876.

WIDNES WATER-WORKS.

THE Widnes Local Board invite Tenders for the sinking of a deep WELL and BORE HOLE upon land adjoining Netherley Bridge, Little Woolton.

Plans and specification may be seen at the Engineer's Office, Public Offices, Widnes.

Tenders, endorsed "Well," and addressed to the Chairman of the Gas and Water Committee, must be left at the above Offices not later than Ten a.m. upon the 31st of July.

The Board do not bind themselves to accept the lowest or any tender.

HENRY ROBERTS.

Public Offices, Widnes, July 4, 1876.

SALFORD CORPORATION GAS-WORKS.

THE Corporation of Salford invite TENDERS for the supply of the CANNEL and COAL required at the various Gas Stations in Salford, for One, Two, or Three years, commencing on the 1st day of September next.

Forms of tender (upon which only tenders will be received) and all particulars may be obtained on application to the Engineer, Mr. Samuel Hunter, Gas-Works, Lamb Lane, Salford.

Tenders, endorsed "Cannel and Coal Contract," to be delivered to me on or before the 28th of July, 1876.

The Corporation do not bind themselves to accept the lowest or any tender.

By order,
CHRIS. MOORHOUSE, Town-Clerk.

Town-Hall, Salford, June 29, 1876.

TO GASHOLDER MAKERS.

THE Town Commissioners of Strabane are prepared to receive TENDERS, with plans and specifications, for the supply and erection of a Single-Lift Gasholder, 35 ft. diameter and 12 ft. high, with the necessary columns, guides, girders, pulleys, chains, counterbalance weights, pipes, valves, dreep closets, pump, pipes, &c., complete.

For further particulars apply to the undersigned, or to N. Tighe, Manager.

The Commissioners do not bind themselves to accept the lowest or any tender, nor will any allowance be made for plans or specifications.

Strabane is only twelve miles from Londonderry, with rail and canal communication.

Tenders received up to the 28th of July.

HUGH MAGUIRE, Clerk to the Commissioners.

TENDERS FOR GAS COAL.

THE Directors of the Glossop Gas Com- pany are prepared to receive TENDERS for a supply of 2300 tons of good, clean GAS COAL, or good clean GAS BURGY COAL, or such quantity of each as they may decide; also 800 tons of good, clean CANNEL, to be delivered in such quantities as the Manager may from time to time require. The whole to be delivered on or before the 1st day of June, 1877.

The Directors do not bind themselves to accept the lowest or any tender, and reserve the right to divide the contract.

Sealed tenders, endorsed "Tender for Coal," giving description of Coal or Cannel, the pits at which it is raised, and the price per ton of 20 cwt., delivered at the Glossop Station of the Manchester, Sheffield, and Lincolnshire Railway Company, to be sent to the undersigned not later than Saturday, the 22nd day of July inst.

By order,
T. H. DANIEL, Manager.

Gas-Works, Glossop, July 10, 1876.

BRITISH ASSOCIATION OF GAS MANAGERS.

VISIT TO BECKTON, JUNE 15, 1876.

PHOTOGRAPHIC GROUPS OF MEMBERS (about 300 in each Picture), taken on the above occasion, can be had at 3s. 6d. each, post free.

Stamps or Post-Office Orders to

F. WELLS, BARKING, ESSEX.

IMPORTANT TO NOTICE.

FERGUSON, Builder and Contractor (better known as "Steeple Jack"), wishes to inform his friends and patrons that the man who was injured at Bromley last week is not in any way connected with him. Neither he nor any of his men has ever met with any accident during the many years he has been in business.

12, CANAL ROAD, MILE END.

CATHELS'S IMPROVED

RETORT-SETTINGS.

GUARANTEED TO HEAT UNIFORMLY WITH THE MINIMUM OF FUEL.

Coloured lithograph copies of Working Drawings of beds, of 1, 2, 3, 5, 6, and 7 Retorts each, so clearly arranged and fully shown, as to be easily understood by any retort-setter or bricklayer, having just been made of these valuable settings, they can now be supplied with detailed specifications, immediately on receipt of orders.

Applications to be made to Mr. THOS. NEWBIGGING, Gas and Consulting Engineer, 5, Norfolk Street, MANCHESTER.

THE NEW MODE OF BUILDING.

TO BUILDERS OR GENTLEMEN WHO WISH TO CONSTRUCT HOUSES ON THE NEW MODE OF BUILDING, ON A SIMPLE LICENCE, IN DISTRICTS NOT AT PRESENT LICENSED.

BY Recent Reductions in the cost of pro- ducing the Apparatus, I am enabled to construct and LET ON HIRE, for periods of not less than three months certain, A SET OF GEAR, consisting of a Hand Block Press, and Moulds for Slabs, and Plain Block Moulds, for 4½-in., 6-in., 9-in., and 12-in. Walls (the Blocks to be either 6 in. or 9 in. in depth, according to order, but in all cases each Block is half a yard in length), on receiving a deposit of £65; the rate charged for hire being 10s. per week for the press, and 1s. 6d. per week for each of the moulds.

Moulds for fluted or grooved Blocks will be loaned at the same rate. On returning the apparatus to the Birkenhead Station, carriage paid, the royalty of 7s. 6d. per habitable room in each house built, and for miscellaneous uses of the Blocks at 2d., 3d., or 4d. per eight Blocks or Slabs, or superficial yard of wall respectively, will be deducted, and the balance of the £65 returned. Full working wear will be allowed, but breakages must be paid for. Small wood gear can be found by the licensee, and be made at any country joiner's shop. The Blocks can be made either in winter or summer, and the minimum thick shell Blocks, with Portland cement, if it costs 80s. per ton, or with sand, bearing a cost of carriage equal to that from London to Birkenhead, these Blocks, with hydraulic lime mortar, and stones for "filling in," yield a profit in many places of 50 per cent. over brickwork, with all the appearance of the best dressed Ashlar Stones, and the walls can be made perfectly waterproof. The thin shell Blocks of "2½ to 1" concrete, with red or grey sand, are the most convenient to make in a country place. If required, a man will be sent with each machine to put it up and work it at 7s. per day, *plus* train and lodging expenses, specially to instruct in one clear day any ordinary workman in the process of making the blocks. A guarantee is given dependent on the average results of the different licensees to a limit of £100, that the buildings constructed on the new mode are superior and more stable than any system of building with bricks and mortar of the same thickness of walls; also that walls of half the usual thickness are, on this principle, sufficiently strong for many of the present building purposes. The order will be placed in course on receiving the deposit.

References: The first buildings, three-storeyed houses, built by John Tainsh, Esq., of Hamilton, N.B., the first licensee in Scotland; the buildings by other licensees now granted in England and Ireland, will be given as soon as they are sufficiently advanced. Bank reference: The National Bank of Liverpool (Birkenhead Branch).

Sole licences are granted by special arrangement.

Send for illustrated circular, enclosing six postage stamps, or card as a Builder or Architect, to 2, Ferry Buildings, Birkenhead.

JOHN C. SELLARS, F.C.S.

EXTRACT FROM THE "BRITISH DAILY MAIL," *Monday, June 5, 1876.*

CONCRETE BUILDING IN HAMILTON.

"There has long been a demand for workmen's houses in the neighbourhood of Hamilton, and although a good many such buildings have been erected of late, the requirement still seems to be in advance of the supply. The great cost of building, both in respect to the high rate of labour, as well as the cost of material, has hitherto had a deterrent effect. With a view of meeting these difficulties, attention has been directed to the use of some material other than stone, brick, and mortar. Mr. J. C. Sellars, of Birkenhead, has recently patented a new invention for building with concrete, composed of sand and cement, and our enterprising townsman, Mr. John Tainsh, has secured the right of using this material in Hamilton. He is now in the course of erecting a large block of three-storeyed houses in the immediate vicinity of the Gas-Works. We purpose explaining the mode of operation to our readers. The material is prepared in hollow Blocks, of about 9 in. by 18 in. over all, and is composed of one-fourth sand to one part Portland cement. * * * The actual building operations now commence, and as the Blocks are accurately fitted and of uniform size, the work is carried on with considerable dispatch by comparatively unskilled labour." * * *

* * * "The surface of the blocks being perfectly smooth, when the joints are pointed the walls require no plastering whatever, and are ready to receive either paper or paint. The advantages in this system of building are numerous, and consist among others of being considerably cheaper, more durable, better adapted to resist damp, and become harder by exposure to the atmosphere, taking up less room, being more sightly in appearance, and besides possessing sanitary advantages over ordinary masonry work. The style of building for lofty edifices looks somewhat slight to the Scotch eye, being, as we are, accustomed to heavy masonry; but looking at it from an English point of view it is fully as substantial as ordinary buildings."

ROTHERHAM CORPORATION GAS-WORKS.

TO IRONFOUNDERS AND ENGINEERS.

THE Gas Committee are prepared to receive TENDERS for the following Contracts:—

CONTRACT No. 1.—A Telescope Gasholder, 127 ft. in diameter.

CONTRACT No. 2.—To supply and erect five cast-iron Columns and sixteen Girders.

CONTRACT No. 3.—To supply material and labour in the Repairs of a Vertical Engine at the Gas-Works.

CONTRACT No. 4.—To supply 80 fluted Lamp-Posts, with cast-iron Lamps. Pattern to be seen at the works.

CONTRACT No. 5.—To supply wrought-iron Service-Pipes and fittings.

The plans and specifications, where requisite, can be seen, and all other necessary information obtained, by applying to Mr. James Goodwin, Manager of the Gas-Works.

The tenders to be sent in on or before the 24th day of July, 1876, endorsed "Tender for Works in the Gas Department."

The Committee do not bind themselves to accept the lowest or any tender.

By order,
W. WHITFIELD, Town-Clerk.

Town-Clerk's Office, Rotherham.

BOROUGH OF BRADFORD.

TO WATER-WORKS CONTRACTORS.

THE Corporation of Bradford are pre- pared to receive TENDERS for the construction of a RESERVOIR at Upper Barden, the embankment being about 525 yards long, and 125 feet high in its deepest part, together with all its necessary bye-channels, waste water courses, tunnel, and syphon outlets; also for the construction of the Gill Beck and Lumb Gill CONDUITS, the lengths of which will be about 2143 yards and 633 yards respectively.

The drawings, sections, and specifications may be examined, and forms of tender and bills of quantities obtained, on payment of three guineas (which will be returned on receipt of a *bonâ fide* tender) from Mr. A. R. Binnie, Water-Works Engineer, Town-Hall, Bradford, between the hours of 10 a.m. and 5 p.m.

Contractors tendering should state what experience they have had in the construction of similar works.

Sealed tenders, in the form supplied by the Engineer, endorsed "Tender for Upper Barden Reservoir and Conduits," addressed to the Chairman of the Water-Works Committee, must be sent to me before 10 a.m. on Monday, the 14th of August next.

The Corporation do not bind themselves to accept the lowest or any tender.

By order,
W. T. M'GOWEN, Town-Clerk.

Town-Clerk's Office, Town-Hall, Bradford,
July 14, 1876.

TO COAL MASTERS AND COAL AGENTS.

THE Directors of the Dumfries Gaslight Company are prepared to receive TENDERS for a supply of GAS COALS, from 1000 to 3000 tons, to be delivered free at the Dumfries Station, as required by the Manager.

Analysis to show at least 27 candles, combined with good coke.

Tenders to be addressed to Mr. MALAM, Gas Manager, DUMFRIES.

Gas-Works, July 14, 1876.

TENDERS FOR GAS COALS.

THE Directors of the Slough Gas and Coke Company are prepared to receive TENDERS for a supply of 1000 tons (21 cwt. to the ton) of either of the undermentioned GAS COALS, viz.:—

New Pelton.
Holmside.
Ravensworth Pelaw, or
Best Screened Silkstone Brights.

Sea Coals to be sheeted, delivered at the Slough Railway Station in such quantities as may be ordered by the Manager of the Works. Of course, parties may tender for either one, two, or the whole of the descriptions named.

Tenders to be delivered to the undersigned, endorsed "Tender for Gas Coals," on or before 6 p.m. on the 20th day of July inst.

ARTHUR THOMAS, Secretary.

Slough, Bucks, July 4, 1876.

Now ready, price 7s., by Post 7s. 3d.,

A SECOND EDITION (fcap. 8vo., morocco gilt)

OF

THE GAS MANAGER'S HANDBOOK,

CONSISTING OF

Tables, Rules, and Useful Information for Gas Engineers, Managers,

And others engaged in the Manufacture and Distribution of

COAL GAS.

BY THOMAS NEWBIGGING, A.I.C.E.

WILLIAM B. KING, 11, BOLT COURT, FLEET STREET, LONDON, E.C.

Will shortly be ready, price 18s., bound in cloth, lettered,

THE TWENTY-SEVENTH VOLUME

(JANUARY TO JUNE, 1876.)

OF THE

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CLOTH CASES, GILT LETTERED,
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Price 2s. 6d.

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JOHN HALL AND CO., STOURBRIDGE,

Manufacturers of FIRE-BRICKS, LUMPS, TILES,

AND EVERY DESCRIPTION OF FIRE-CLAY GOODS.

N.B.—A Stock of 15 and 16 in. CIRCULAR RETORTS always on hand. Other kinds made to order on short Notice.

ALFRED WILLIAMS,

PHŒNIX FIRE-BRICK WHARF,

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GAS ENGINEER AND CONTRACTOR FOR THE ERECTION OF GAS-WORKS,
AND FOR THE
SUPPLY OF RETORTS, FIRE-BRICKS, CAST-IRON MAINS,
AND ALL MATERIALS FOR GAS MANUFACTURE AND DISTRIBUTION.

JAMES MILNE & SON,

GAS ENGINEERS,

Gas-Meter, Gas Apparatus, and Gas-Fittings Manufacturers,

EDINBURGH, AND

2, KING EDWARD STREET,

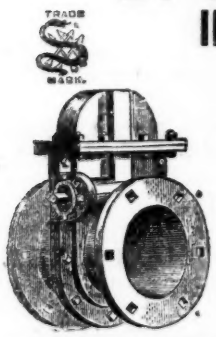
NEWGATE STREET, LONDON.

Meter Works in London—2, CROSS STREET, WILDERNESS ROW, E.C.

STATION-METERS, GOVERNORS, CONSUMERS METERS, GAS LUSTRES, CHANDELIERS, BRACKETS, &c.,

And every description of Gas-Fittings and Gas Apparatus.

B. DONKIN & CO.'S
IMPROVED GAS-VALVES



WITH WROUGHT-IRON PINIONS,

List of prices, with full dimensions of all sizes up to 48-inch, to be had on application.

These Valves are all proved on both sides to 30 lbs. on the square inch before leaving the works, and are always kept in stock.

VALVES MADE WITH OUTSIDE RACKS TO ORDER.
ALSO, SCREW WATER-VALVES WITH GUN-METAL FACES.
ALSO SOLE MAKERS OF
J. BEALE'S NEW PATENT GAS EXHAUSTERS.

B. DONKIN & CO.,
GENERAL ENGINEERS AND IRONFOUNDERS,
MAKERS OF STEAM-ENGINES,
55a, BLUE ANCHOR ROAD, BERMONDSEY,
LONDON, S.E.

TO GAS COMPANIES AND THE TRADE.

J. DEFRIES & SONS,

MANUFACTURERS OF

CRYSTAL, BRONZED, & ORMOLU CHANDELIERS, IMPROVED CRYSTAL STAR & SUN LIGHTS, VESTIBULE LAMPS, AND THE PATENT CRYSTAL ILLUMINATION.

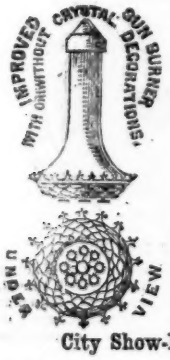
A LARGE STOCK ALWAYS IN HAND OF

IRON, BRASS, COMPOSITE, AND LEAD TUBES, FOR GAS AND WATER,
AND EVERY DESCRIPTION OF
GAS AND WATER FITTINGS.

THE PATENT DRY AND WET METER, WITH THE LATEST IMPROVEMENTS.

STREET LAMPS AND COLUMNS IN GREAT VARIETY.

WORKS: LONDON AND BIRMINGHAM.



GAS MOONS,
Cut and Engraved, of the newest designs

GAS REFLECTORS
In Silver and Glass

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AND
BURNERS
Of every description.

Pattern-Books of Gas-Fittings, Crystal and Ormolu Chandeliers for 1876, are now complete.

City Show-Rooms and Manufactory, 147, HOUNDSDITCH, LONDON.
ESTABLISHED 1830.

T. NEWBIGGING,

CONSULTING GAS ENGINEER,

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Mr. ALFRED LASS,

60, CORNHILL, LONDON, E.C.,

Is prepared to open the Books, and, if necessary, keep the Accounts of Gas and Water Companies.

To examine the Books and Accounts, and prepare Balance-Sheets for the information of Directors.

To assist Secretaries in preparing Balance-Sheets, according to the "Gas-Works Clauses Act, 1871;" or may be consulted with respect to Accounts generally.

D. M. NELSON,

48, GORDON STREET (late 135, BUCHANAN ST.),
GLASGOW,

Supplies every requisite in connexion with the distribution of Gas and Water.

Estimates and prices on application.
WOOD GRIDS for Purifiers and Scrubbers.
Cast-Iron PIPES and VALVES.
Street LAMP-PILLARS.
Patent Pipe SCREWING-MACHINES, &c.

TO INVENTORS AND PATENTEES.

MR. W. H. BENNETT, having had considerable experience in matters connected with Gas, Water, and Sanitary Improvement, begs to say that he continues to assist Inventors in the perfection of their designs, and to obtain for them PROVISIONAL PROTECTION, whereby their invention may be secured for Six Months; or LETTERS PATENT, which are granted for Fourteen Years.

Patents completed, or proceeded with at any stage, thereby rendering it unnecessary for persons resident in the country to visit London.

Patents procured for Foreign Countries.

Information as to cost, &c., supplied gratuitously upon application to the Advertiser, 22, Great George Street WESTMINSTER.

CATHELS'S Patent District Dry Gas-GOVERNOR is the only perfect self-acting contrivance for Regulating the Pressures in the higher levels of a district.

For prices, &c., apply to the Manufacturers, Messrs. GUEST AND CHRIMES, ROTHERHAM.

CATHELS & TERRACE'S Patent Four-WAY DISC GAS-VALVE is the simplest and best Valve for Purifiers, and as a By-pass for other apparatus in Gas-Works. It is always gas-tight, and has no springs, ground faces, or other delicate parts. By its use the flow of the gas cannot be accidentally stopped, and it never sticks.

For prices, &c., apply to the Manufacturers, Messrs. GUEST AND CHRIMES, Foundry and Brass Works, ROTHERHAM.

INTERNATIONAL EXHIBITION, 1862.
CLASS X.
PRIZE MEDAL
For excellence of Fire-Clay Gas Retorts, and
"HONOURABLE MENTION" for
good quality of Fire-Bricks.

WILLIAM STEPHENSON & SONS,
THROCKLEY,
NEWCASTLE-ON-TYNE.

JOHN DEPLEDGE,

Inventor of the

DRY-FACED CENTRE-VALVE FOR PURIFIERS,

GAS AND HOT WATER ENGINEER,

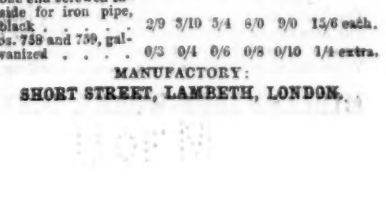
20, BRIDGEHOUSES, SHEFFIELD.

LAMBERT'S
CAST-IRON GAS-MAIN COCKS,

WITH PATENT WHITE METAL PLUGS.

TRADE (L) MARK.

No. 758. No. 759.



The bodies of these Taps are made of iron, black or galvanized, and the plugs of patent metal. They are warranted not to set fast or corrode, as do Iron or Brass Cocks; will always work easily; are strong, well made, durable; of little or no intrinsic value, and therefore not likely to be stolen; and the prices as stated below are (especially upon the larger sizes) fully 50 per cent. less than Brass Cocks.

	½	¾	1	1¼	1½	2-inch.
No. 758, with inside screws for iron pipe, black	2/0	3/0	4/4	6/6	7/6	12/0 each.
No. 759, with union on one end screwed inside for iron pipe, black	2/9	3/10	5/4	6/0	9/0	15/6 each.
Nos. 758 and 759, galvanized	0/3	0/4	0/6	0/8	0/10	1/4 extra.

MANUFACTORY:
SHORT STREET, LAMBETH, LONDON.

Just published, price 10s. 6d.,

REGISTRATION OF DISTRIBUTORY PLANT.

The forms for this purpose are to illustrate the Paper on Distribution of Gas, read at the Edinburgh Meeting of the British Association of Gas Managers. By the use of the synopsis the whole of the out-door plant may at once be seen, with all matters pertaining to the same.

W. J. WARNER, Engineer.

South Shields.

PLUTONIC CEMENT,

For Repairing Gas-Retorts in Action, preventing Porosity, and reducing the Deposit of Carbon, is highly commended.

WILLIAM RICHARDSON,

GAS AND HYDRAULIC ENGINEER,

CHARLES HENRY STREET AND BISSELL STREET, BIRMINGHAM.

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(ESTABLISHED 1851.)

TRADE MARK

These Paints have been for many years extensively used in Her Majesty's Royal Dockyards, Woolwich Arsenal, the Shorncliffe and Curragh Camps, War Departments, and Colonies, and are largely supplied to Railway, Harbour, and GAS COMPANIES, Shipowners, Engineering Establishments, Railway Carriage and Waggon Works, and the Paint Trade generally. They are the BEST PROTECTORS of IRONWORK, even arresting corrosion after it has set in; and their base being oxide of iron, they are free from those properties which make lead paints so destructive to ironwork. They do not scale or blister, are not affected by great heat, and are the only Paints which will resist the effects of sulphuretted hydrogen. Their DURABILITY and covering properties have borne the test of A QUARTER OF A CENTURY'S PRACTICAL TRIAL.

The undermentioned colours—ground in best linseed oil, and requiring only before use to be thinned down in the ordinary way—are kept in stock:—

Torbay Brown.	Torbay Red.
Dart Green.	Slate.
Dart Yellow.	Buff.
Brixham Black.	Torbay Chocolate.
Light Blue.	Cream Colour.
Dart Brown.	Dart Umber.
Imperial Stone.	Light Stone.
Bronze Green.	Salmon Colour.
Navy Green.	Lead.
Carriage Red.	Dark Stone.
Light Lead.	Crystal Palace Blue.
Light Green.	Iron Grey.

All other Colours made to order.

PRICES and TESTIMONIALS on APPLICATION.

GEORGE ORME & CO.,

ATLAS METER-WORKS, OLDHAM,

MANUFACTURERS OF

WET AND DRY GAS-METERS,

STATION-METERS, GOVERNORS,

PRESSURE AND EXHAUST REGISTERS,

LAMP-METERS IN CAST-IRON BOXES,

And every Description of Gas Apparatus.

J. T. B. PORTER & CO.,

GAS ENGINEERS & MANUFACTURERS,

IRONFOUNDERS AND CONTRACTORS,

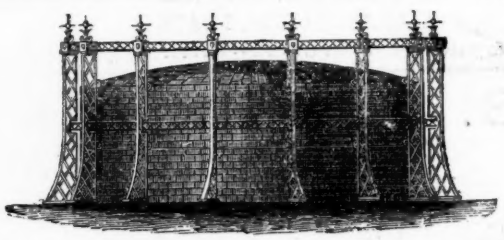
GOWTS BRIDGE WORKS,

LINCOLN.

ESTIMATES FOR GAS-WORKS OF ANY SIZE.

REFERENCES TO 500 WORKS ALREADY ERECTED.

N.B.—It is most particularly requested that all Communications be addressed to the FIRM ONLY, as circumstances have arisen which render this necessary.



THE HORSELEY COMPANY,

LIMITED,

TIPTON, STAFFORDSHIRE.

LONDON OFFICE:

6, WESTMINSTER CHAMBERS, VICTORIA STREET,

GAS ENGINEERS, IRONFOUNDERS, &c.,

MANUFACTURERS OF

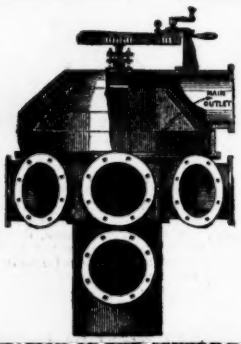
GASHOLDERS, WROUGHT AND CAST IRON TANKS, CONDENSERS, PURIFIERS, SCRUBBERS, MAINS, RETORT-LIDS, PLAIN AND DISHED, LAMP-POSTS, PIPES,

AND ALL REQUISITES FOR EITHER

GAS OR WATER WORKS;

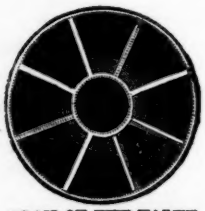
ALSO

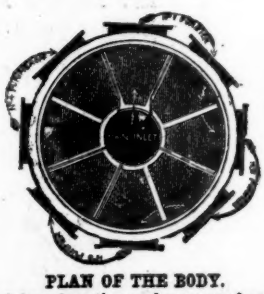
MAKERS OF ROOFS, BRIDGES, &c.



C. & W. WALKERS'

PATENT CENTRE-VALVES.





ELEVATION OF THE CENTRE-VALVE. PLAN OF THE VALVE. PLAN OF THE BODY.

These PATENT CENTRE-VALVES are the most perfect and certain means for working Purifiers on the system of three in action, and one out of action. The Valve itself is protected from all injury inside the safety cover. The working of the Valve is so easy, and so governed by the stop-catch movement, that the Purifiers can be instantaneously changed in the dark as well as in daylight. They are scraped perfectly true, metal to metal, the facings heretofore exposed are always covered, and there is nothing more reliable, certain, and durable in a gas-works. By their use the floor of the Purifying-house is clear and level; the Valve and all connexions being beneath the floor, out of the way of working. A considerable improvement and saving is effected in the cost of the connecting-pipes.

MIDLAND IRON-WORKS, DONNINGTON, near NEWPORT, SHROPSHIRE; 8, FINSBURY CIRCUS, LONDON.

C. & W. WALKER,
8, Finsbury Circus,
London, E.C.

MANN & WALKERS' PATENT SCRUBBER.

By Letters Patent in Great Britain, Europe, and the United States of America.

By some important improvements recently patented, the purifying power of these Scrubbers has been much increased, and a stronger ammoniacal solution obtained, which is found to absorb a large portion of the carbonic acid contained in gas, effecting an important saving in money and labour in the lime purifiers, and where oxide only is used, the increase in the illuminating power of the gas obtained by these Scrubbers is shown in a remarkable degree, in consequence of the large quantity of carbonic acid removed from the gas.

It is to be particularly noted that the im- portant results of these Scrubbers do not depend upon the machinery alone. The entire internal construction of the Scrubber bears an almost equally important part. For this reason, where it is desirable to convert existing Scrubbers, whose dimensions happen to be suitable, the work commences by ripping out the whole of the interior of the shell, and beginning the internal construction *de novo* from bottom to top.

They are, in all cases, constructed under guarantees to perfectly perform their work. They are now extensively used in the largest gas-works of London and the chief cities of Europe, the number in use exceeds **one hundred,** and their perfect efficiency and profit to a gas company have been fully established with every variety of coal used in Europe. References can be given to the largest gas-works in Europe.

By their use the department of purification from ammonia upon a gas-works is made complete, without the aid of prepared oxide of iron, chemicals in purifiers, or any other supplementary process, and the whole ammoniacal residual product contained in the coal is absorbed and obtained in the form most profitable to a gas company, while the requirements of all Acts of Parliament and of the Board of Trade, relating to incorporate gas companies, are satisfied.

Foul Gas, properly condensed, entering the inlet is, by once only passing through the Scrubber, completely purified from ammonia with regular certainty day by day, without any further trouble, or any other process, effected by a very small quantity of clear water let into the machinery room at the top of the Scrubber, which is discharged at the liquor outlet at the bottom, from Newcastle coal at about 18 to 20 ounces strength, from Yorkshire and other coals, generally from 25 to 30 ounces strength; while acidulated litmus or turmeric exposed at the Scrubber outlet will not show the slightest discoloration, and there is not a quarter of a grain of ammonia per 100 feet left unabsorbed.

They contain their own engine power, re- quiring only a small inappreciable quantity of steam from the gas-works boiler, and are then complete in themselves, ready for service.

Applications relating to dimensions and prices should be addressed to us, C. and W. Walker, 8, Finsbury Circus, London, E.C., or to Mr. William Mann, late Superintendent of the Chartered Gas-Works, Blackfriars, London; they should state approximately the largest make of gas in 24 hours on a winter's day, and the smallest make on a summer's day, to be purified.

1862.

PATENT ANTIMONY PAINT.

MADE ONLY BY

GEORGE HALLETT & CO.,

296, ROTHERHITHE, LONDON, S.E.

CLASS II.

1862 LONDINI HONORIS CAUSA

This Paint having been in general use over fourteen years (especially in some of the principal Gas-Works), and proved itself the best light-coloured Paint produced for resisting the influence of vitiated atmospheres, it is important that its qualities should be more widely known.

It is not discoloured like white lead in a sulphuretted atmosphere, nor washed off like white zinc; and its light colour reflecting heat, produces much less expansion of gas in holders painted with it than with dark colours, besides rendering them much more sightly. Its specific gravity is so much below white lead that the same weight will cover one-third more surface, while it is equal in body; and its price being about the same (30s. per cwt.), it is actually one-third cheaper. From experience, its manufacture is greatly improved, and it is quite suitable for all purposes in which white lead is employed.

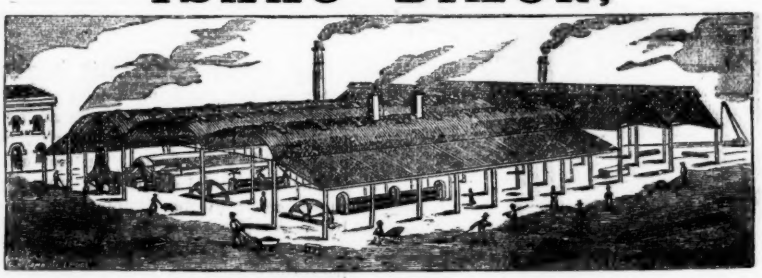
The following Gas Companies in London have used the Paint for years—viz., The Gaslight and Coke, Imperial, Independent, City of London, Commercial, London, and Surrey Consumers.

N.B.—Antimony Paint, COVERING SO MUCH MORE WORK, costs about 20s. per cwt., as compared with White Lead at 30s. per cwt.; a similar economy arises from its use in Steam and Gas Joints, for which purpose it is superior to White Lead.

SPECIAL DRIERS FOR ANTIMONY PAINT SUPPLIED.

ISAAC DIXON,

WINDSOR IRON-WORKS, LIVERPOOL.



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Manufacturer of SELF-SUPPORTING GALVANIZED CORRUGATED, CURVED, and every kind of IRON ROOFING, CHURCHES, SCHOOLS, SHEDS, and IRON BUILDINGS.

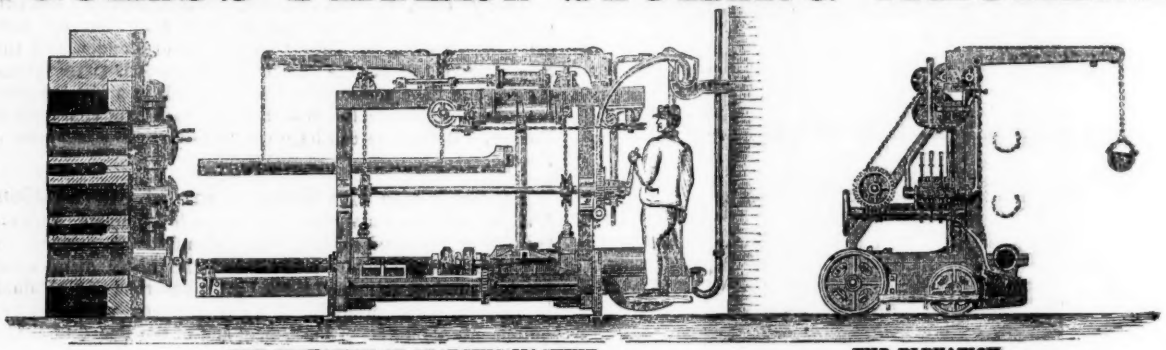
WROUGHT and CAST IRON GIRDERS, BRIDGES, TANKS, &c., and all kinds of WIRE WORK, FENCING, GATES, HURDLES, &c., for Home or Abroad.

DIXON'S CELEBRATED SELF-SUPPORTING IRON ROOFS are specially suitable for Forges, Rolling-Mills, Iron-Works, Shipbuilding Yards, Mines, Collieries, Gas and Water Works, and for general purposes.

For Roofs with Timber Framing, DIXON'S GALVANIZED OR TARRED IRON SLATES form a durable and cheap covering, costing only about the same, when fixed, as felt and boards.

DRAWINGS, ESTIMATES, AND ILLUSTRATED CATALOGUES MAY BE OBTAINED ON APPLICATION.

FOULIS'S PATENT STOKING MACHINE.



SIDE ELEVATION OF CHARGING MACHINE. END ELEVATION

(*The Drawing Machine will be Illustrated in next week's Advertisement.*)

Makers: TANGYE BROTHERS and HOLMAN, London and Birmingham; ADAM WOODWARD and SON, Manchester ROBERT LAIDLAW and SON, Glasgow; MASCHINENBAU-ACTIEN-GESELLSCHAFT HUMBOLDT, Kalk bei Deutz; Or all particulars may be had from JAMES WOTHERSPOON, 31, St. Vincent Place, Glasgow.

MEDAL AND HONORABLE MENTION EXCELLENCE STONEWARE MANUFACTURE DRAIN PIPES MATERIAL LARGE SIZE CLAY RETORTS

Established

1795.

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WORTLEY FIRE-BRICK WORKS,

NEAR LEEDS,

MANUFACTURERS OF ALL DESCRIPTIONS OF

FIRE GOODS, and Salt-Glazed Drain-Pipes.

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Where is always kept a Stock of Retorts, Fire-Bricks, Terra Cotta Ware, and Drain-Pipes.

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(ESTABLISHED 1827,)

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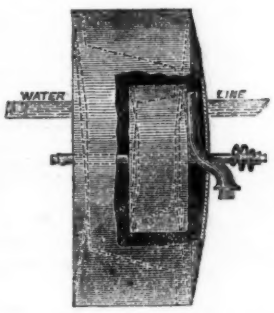
MILLBANK STREET,
(NEAR THE HOUSES OF PARLIAMENT.) **LONDON, S.W.**

BUCCLEUCH ST. WORKS,
EDINBURGH.

From "THE JOURNAL OF GAS LIGHTING," Jan. 5, 1875.

"The changes effected in the construction of the wet meter are such that it now occupies a position which it never held before—that of an unvarying measure. . . . Both company and consumer are now equally protected, perfect accuracy of measurement is obtained, and that, too, without the least increase of mechanism, or the action of the meter in the least degree being prejudicially affected."



BRITISH ASSOCIATION of GAS MANAGERS, Leeds, 1875.

Inaugural Address of the President, JAMES PATERSON, Esq., F.G.S., of Warrington.

"There are, however, degrees of what may properly be termed excellence; and this leads me to notice one of the most beautiful applications which science has yet devised in the construction of the meter, and which has rendered it an absolutely reliable and unvarying instrument. . . . The object aimed at, and most admirably accomplished, is to change the varying measurement of a varying water-line to an unvarying measure with a varying water-line and annulus."

WARNER & COWAN'S
PATENT
"SELF-REGULATING DRUM" GAS-METER.

It is the ONLY Meter in which reliance can be placed.

It is the ONLY Meter in which the DRUM or WHEEL has been improved since it left the hands of Clegg and Crosley.

It is the ONLY Meter that POSSESSES AN UNVARYING MEASURING-CHAMBER.

It is the ONLY Meter FREE FROM delicate and complex compensating arrangements for maintaining water-line.

W. & B. COWAN,

(ESTABLISHED 1827,)

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(NEAR THE HOUSES OF PARLIAMENT.) **LONDON, S.W.**

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W. & B. COWAN'S large and increasing Export Trade is provided for by their keeping constantly on hand a very large stock of both Wet and Dry Meters, ready for immediate despatch to the British Colonies and Foreign Countries.

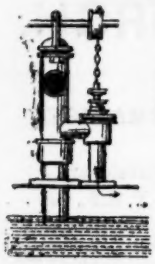
BAILEY'S Patented Inventions are now in extensive use wherever steam is known. Bailey's Patent Steam Gauges, Pyrometers, Water Gauge Cocks, Test Pumps, Fusible Plugs, Steam and Water Valves, Safety Valves, Junction Valves, Pumps, Tell-Tales, Recorders, Lightning Conductors, Electric Telegraphs, Turret Clocks, Steam Joint Cement, Lifting Jacks, Boiler Feeders, Lime Catcher and Separator, Injectors and Ejectors, and every description of first-class Brass Work for Engines and Boilers. Gas-Works Managers who have not our large book should send for it.

16th edition, 1000 engravings, 4to., post free 2s. in stamps, weight 10 oz., cost of production £1000,

BAILEY'S Illustrated Inventions, containing details and prices of goods in our five several departments:—(1) Brass Foundry, Steam Gauges, Indicators, Feeders, and Fittings; (2) Engineers Sundries, Small Tools, and Stores; (3) Machine Pump and Fire Engine; (4) Turret Clock, &c.; (5) Electric Telegraph, A B C Instruments, Bells, and Apparatus.

J. BAILEY and Co., Albion Works, Salford, LANCASHIRE.

COPP'S PATENT ANTI-DIP GAS APPARATUS.



Produces from 10 to 20 per cent. more gas of higher illuminating power.
Prevents the deposit of carbon.
Retorts last much longer.
Charges work off quicker.
This simple invention has been in use in many works for the last six months, with the above results.

PRICE 2 GUINEAS EACH

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GAS-LAMPS, FOUNTAINS.

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LIFT PUMPS,
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SYPHON PUMPS.

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With bow-handle . . . . 16s. 0d.

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GAS-VALVES,
AT GREATLY
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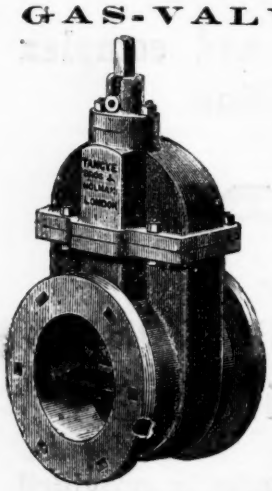
PRICES.



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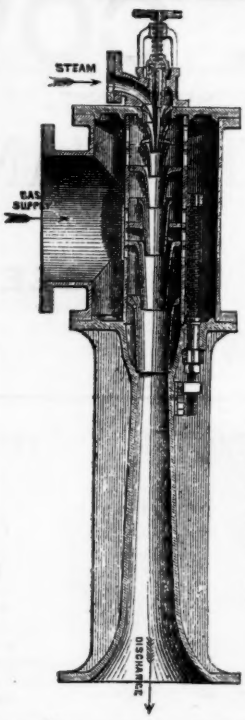
5	40	0
6	66	0
7	81	0
8	96	0
10	100	0
14	140	0

TANGYE BROS. & HOLMAN,
LAURENCE POUNTNEY LANE,
LONDON.

KÖRTING BROS.,

Steam-Jet Engineers,
SOLE LICENSEES FOR
W. CLELAND'S PATENT STEAM-JET GAS-EXHAUSTER,
AND
W. CLELAND'S PATENT STEAM SCRUBBER,
7 and 17, LANCASTER AVENUE,
MANCHESTER.

Germany: Cellerstr. 35, Hannover. Austria: Kolring., Pestalozzigasse 6, Vienna.
France: 11, Rue Louis-le-Grand, Paris. U. S.: 1645, N. 10th St., Philadelphia.



E. KÖRTING'S PATENT
STEAM-JET GAS-EXHAUSTER.

Small Cost—Compactness—Perfectly Self-Acting—
Self-Regulating—Self-Cleansing—No Steam-Engine—No Attention—
No Extra Room Required—No Wear and Tear—No Noise—
No Oscillation in Vacuum, or Back Pressure.

UPWARDS OF 200 IN USE.
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Epsom and Ewell Gas Co.	Birmingham Gas-Works.	
Ipswich Gas Co.	Wakefield Gas-Works.	Ratcliff Gas-Works.
Cheltenham Gas Co.	Brentford Gas-Works.	Kendal Gas-Works.
	&c., &c., &c.	

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W. CLELAND'S PATENT STEAM SCRUBBER,
Combining small cost and thorough efficiency, with absence of any mechanical means and necessity of renewing the scrubbing material

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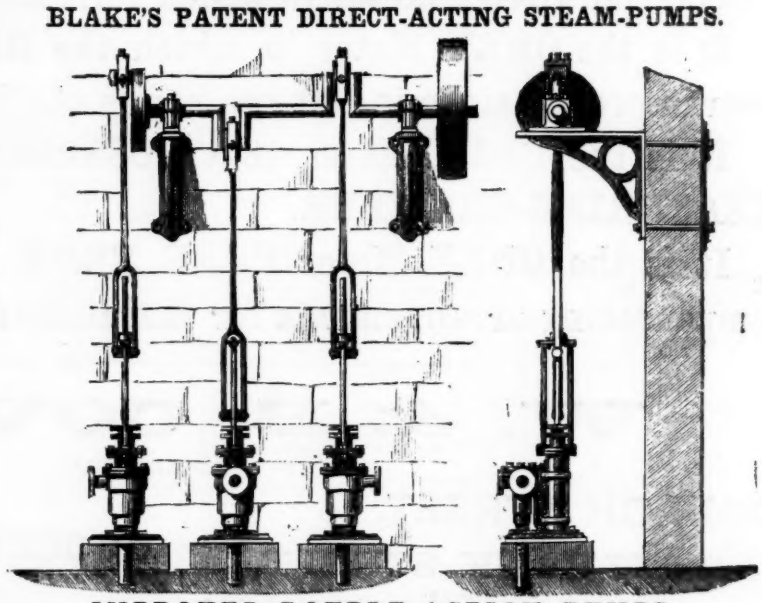
SOLE LICENSEES AND MANUFACTURERS FOR GREAT BRITAIN OF
BLAKE'S PATENT DIRECT-ACTING STEAM-PUMPS.



IMPROVED DOUBLE-ACTION PUMPS.
For Water. For Tar. For Ammoniacal Liquor.

This illustration shows an arrangement of three (No. 179) Improved Double-Action Pumps driven from the same crank-shaft, as frequently supplied for use in Gas and Chemical Works. The suction and discharge pipes can be arranged for drawing from and delivering in any required direction.

These Pumps have been supplied to nearly all the large Gas Companies and Chemical Works, both for Pumping Water, Tar, and Ammoniacal Liquor.

GAS SYPHON PUMPS, IN COPPER OR SHEET IRON, ALWAYS IN STOCK.

Illustrated Catalogues sent post free on application.

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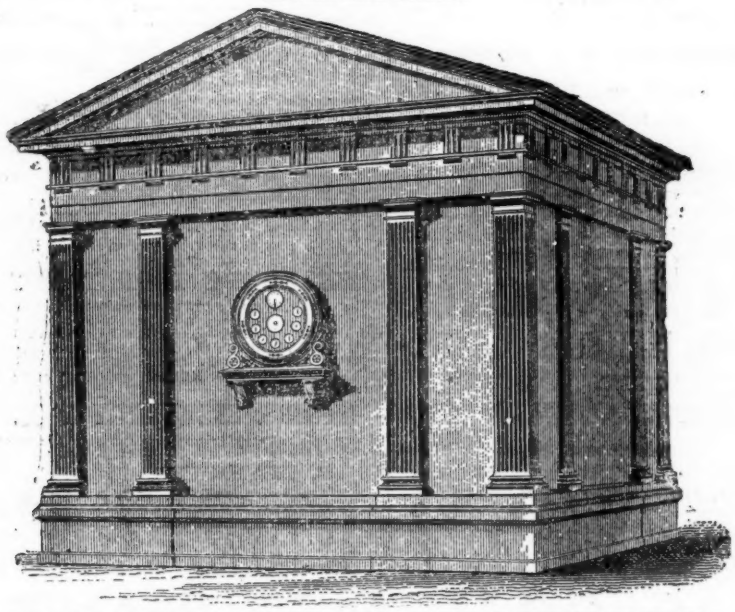
ROUND STATION-METERS,

ON CAST-IRON STANDS.



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WITH PLANED JOINTS.

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GAS COOKING APPARATUS.

Home and Foreign Orders promptly attended to.

All Sizes of CONSUMERS METERS, STATION-METERS, and GOVERNORS generally in Stock.

Orders almost invariably despatched on the day of receipt.

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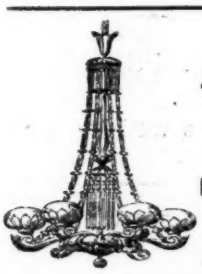

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BROAD STREET, BIRMINGHAM.

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TABLE GLASS OF ALL KINDS.

CHANDELIERS IN BRONZE AND ORMOLU. MODERATOR LAMPS.

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GAS AND CONSULTING ENGINEER,

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WESTMINSTER, S.W.

PATENTEE and MANUFACTURER of the following Inventions:—

RETORT SETTINGS—giving great Economy of Fuel.

STEAM-ENGINES and EXHAUSTERS, FOUR-WAY VALVES.

FUEL-MACHINE, for Compressing Breeze and Tar.

WASHERS, SCRUBBERS, and PURIFIERS, that Economize Space and Cost.

N.B.—Pamphlet, with Eighteen Illustrations of the foregoing, with letterpress on the construction of Gas-Works, post free, 2s. 6d.

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FIRE CLAY & BRICK WORKS,

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Manufacturers of GAS-RETORTS, GLASS-HOUSE FURNACE & BLAST-FURNACE BRICKS LUMPS, TILES, and every description of FIRE-BRICK.

Proprietors of

BEST GLASS-HOUSE POT and CRUCIBLE CLAYS.

Successors to

E. BAKER AND CO., LATE BRIERLEY HILL, STAFFORDSHIRE.

"SELLARS' CEMENT"

PREVENTS WASTE OF GAS FROM RETORTS;

SAVES CLAY RETORTS FROM DESTRUCTION BY FIRE;

GREATLY ECONOMIZES THE USE OF FIRE-BRICKS;

And PREVENTS ALL POSSIBLE LOSS of GAS FROM LEAKAGE.

J. C. SELLARS,

THE GAS CEMENT WORKS,

BIRKENHEAD.

B. CARPENTER,

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THE ORIGINAL MANUFACTURER OF

WOOD SIEVES

FOR

GAS PURIFIERS & SCRUBBERS.

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RENOWNED

WOOD SIEVES,

WITH TAPER BARS,

MADE BY MACHINERY

CAPABLE OF MAKING 10,000 PERT WEEKLY.

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As supplied to the Imperial, Chartered, and other London and Provincial Gas Companies. Bellows and Valves for inflating Well Dresses, Stokers Gloves, India-Rubber Suction and Delivery Hose, Gas-Tubing, Leather India-Rubber and Gutta-Percha Machine-Bands, Sheet and Washers anc Steam Joints.

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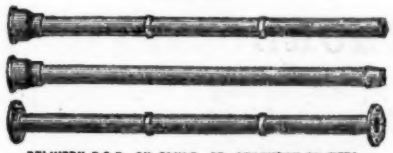

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Yields 13,320 cubic feet of 32·5-candle gas per ton.

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COPPA COLLIERY, MOLD,

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CANNEL FOR GAS-MAKING PURPOSES.

This Cannel produces in actual working, in iron retorts, 9000 cubic feet of 32-candle gas, and upwards of 11 cwt. of coke, and in clay retorts will produce 11,500 cubic feet of 25·9-candle gas.

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Keep in London and at their works large stocks of PIPES and CONNEXIONS (1½ to 36 inches in diameter); also make and supply Retorts, Tanks, Columns, Girders, Special Castings required by Gas, Water, Railway, Telegraph, Chemical, Colliery, and other Companies.

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Cubic feet of Gas yielded per ton . . .	10,050
Illuminating power in sperm candles . .	15·4
Yield of coke per ton of good quality . .	13½ cwts.

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Are prepared to supply their

SCREENED AND NUT GAS COALS.

This Coal yields 11,000 cubic feet of gas and 13½ cwts. of coke per ton.

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NEAR SHEFFIELD,

STRONGLY RECOMMEND A TRIAL OF THEIR

CELEBRATED SILKSTONE GAS NUTS.

Analysis by F. J. EVANS, Esq., Chartered Gas Company, Horseferry Road, Westminster:—

(COPY.)

	Cubic Feet of Gas per Ton of Coal.	Illuminating Power in Candles.	Coke per Ton of Coal used.	Ash in Coke, per Cent.	Sulphur in Coal, per Cent.
Silkstone Nuts . . .	10·800	15·85	12·66 cwt.....	6·0	0·69

NOTE.—The illuminating power of the gas was tested by the standard burner now used in London by the Gas Referees, under the City of London Gas Act, 1868.

Horseferry Road, Westminster, March, 1870. (Signed) F. J. EVANS.

These Nuts are extensively used by various Gas Companies throughout the Kingdom, who bear strong testimony to their value.

APPLICATIONS FOR PRICES, &c., TO BE SENT DIRECT TO THE COLLIERY, AS ABOVE.

THE SILKSTONE & DODWORTH COAL & IRON COMPANY, LIMITED,

DODWORTH, BARNSLEY.

BENJAMIN WHITWORTH, Esq., M.P. . . . . Chairman.
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REAL OLD SILKSTONE GAS COAL.

JAMES PATERSON, Esq., Gas Engineer, of the Warrington Gas Company, reported, Aug. 10, 1875:—

"This Coal possesses remarkable qualities as a gas and coking coal, and appears SECOND TO NONE IN THE KINGDOM. It contains the large quantity of 699 lbs. of illuminating matter, and 1498 lbs. of coke to the ton, and produces **12,240** cubic feet of 16·66 candle gas."

The above Company are raising nearly a thousand tons of the Real Old Silkstone Gas Coal per working day.

PRICES QUOTED TO ANY RAILWAY STATION, OR F.O.B. HULL, GRIMSBY, GOOLE, KEADBY, LIVERPOOL, AND FLEETWOOD.

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THE DERBYSHIRE
SILKSTONE COAL COMPANY,
LIMITED,

CAN OFFER A

GAS COAL

Of superior quality, delivered at any station in England and Wales.

Purified gas per ton of coal in cubic feet (average)	**10,775**
Weight of coke in lbs. per ton of coal	**1,465**

ANALYSIS AND PRICES ON APPLICATION TO

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ALBERT COLLIERY, NEWBOLD, NEAR CHESTERFIELD.

THE LOCHORE AND CAPLEDRAE CANNEL COAL

COMPANY, LIMITED.

Works: LOCHORE by LOCHGELLY, FIFESHIRE. Office: CUSTOM HOUSE CHAMBERS, LEITH.

This Company request attention to the very superior quality of their Cannel Coals.

1. The following are the practical results given by Dr. Wallace, of Glasgow, of analyses of their Lochore and Capledrae Cannels:—

	Sample worked at Capledrae.	Sample worked at Lochore
Gas per ton of coal, at 60° Fahr. and 30 inches barometric pressure . .	13,095 cubic feet.	11,760 cubic feet.
Illuminating power, in standard sperm candles, by union jet consuming 5 cubic feet per hour, at ·5-inch pressure	32·91	34·83
Value of 1 cubic foot of gas in grains of sperm	780	836
Equivalent of a ton of coal in pounds of sperm candles	1,459	1,404
Durability of 1 cubic foot by 5-inch flame	69 minutes.	71 minutes.
Gravity of the gas (air = 1000)	596	594

Remarks.—This (the sample from Capledrae) is a Cannel Coal of first-class quality, giving 13,000 feet of 33-candle gas. It contains only a minute proportion of sulphur, and the ash is almost quite white. The coke is of rather inferior quality.

Remarks on Sample from Lochore.—This is a Cannel Coal of first-class quality, giving a large yield of very rich gas and a coke of medium quality.

2. The following are the practical results of analyses by Dr. Wallace of the Company's Waverley Cannels:—

	Capledrae Waverley.	Lochore Waverley.
Gas per ton of coal, at 60° Fahr. and 30 inches barometer	9,120 cubic feet.	11,145 cubic feet.
Illuminating power, in standard candles, by union jet consuming 5 cubic feet per hour, at ·5-inch pressure	36·62	33·09
Value of 1 cubic foot of gas in grains of sperm	878	794
Equivalent of a ton of coal in pounds of sperm candles	1,145	1,264
Durability of 1 cubic foot of gas by 5-inch flame	80 minutes.	67 minutes.
Gravity of the gas (air = 1000)	677	597

Remarks on the Sample of Capledrae Waverley.—This Coal gives fully 9000 feet of gas of 36½ candles, and is admirably adapted for bringing up the quality of gas made from common coal or inferior qualities of cannel. The tests were made at a rather high temperature, this being one of the coals that stand a very high heat without serious diminution of the illuminating power of the gas The coke contains 60 per cent. of ash, and is therefore almost valueless, but the proportion of sulphur is very moderate.

Remarks on the Lochore Waverley.—This is a first-class Cannel Coal, giving 11,000 cubic feet of 33-candle gas. The quantity of sulphur is very minute, and the ash is nearly white. The coke is of inferior quality, but not wholly valueless.

Applications for full Copies of Analyses and Prices may be made to the Company.

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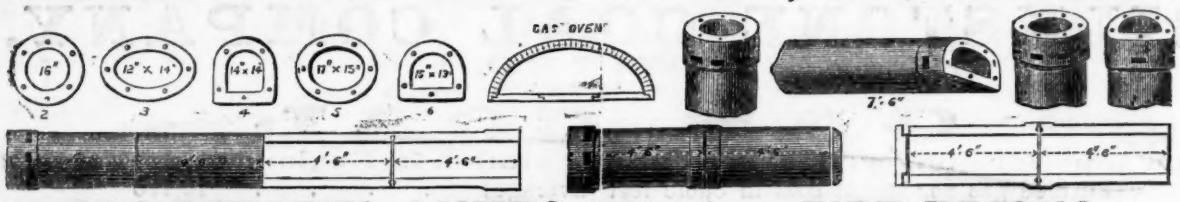

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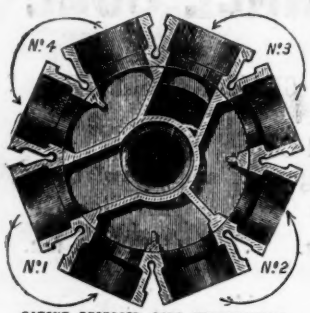

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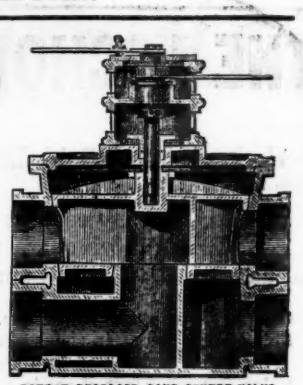

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